

YIL / YEAR | 2025

CİLT - SAYI / VOLUME - ISSUE | 33 / 03

e-ISSN | 2147-9844

KASTAMONU ÜNİVERSİTESİ
KASTAMONU EĞİTİM DERGİSİ

KASTAMONU UNIVERSITY
KASTAMONU EDUCATION JOURNAL





KASTAMONU ÜNİVERSİTESİ KASTAMONU UNIVERSITY
KASTAMONU EĞİTİM DERGİSİ KASTAMONU EDUCATION JOURNAL

SAHİBİ | OWNER

Prof. Dr. Ahmet Hamdi TOPAL
Kastamonu Üniversitesi Rektörü | Rector of Kastamonu University

YAYINCI | PUBLISHER

Kastamonu Üniversitesi | Kastamonu University

BAŞ EDITÖR | EDITOR-IN-CHIEF

Doç. Dr. Muammer ERGÜN

YARDIMCI EDITÖRLER | ASSOCIATE EDITORS

Doç. Dr. Adem YILMAZ, Kastamonu Üniversitesi
Dr. İbrahim Fatih DEMİREL, Kastamonu Üniversitesi

TEKNİK EDITÖRLER | TECHNICAL EDITORS

Doç. Dr. Adem YILMAZ, Kastamonu Üniversitesi

DİL EDITÖRÜ | LANGUAGE EDITOR

Dr. Ersin ARSLAN, Kastamonu Üniversitesi

İLETİŞİM | CONTACT

Kastamonu Üniversitesi Eğitim Fakültesi, Kastamonu, TÜRKİYE

90 366 2803311

kefdergi@kastamonu.edu.tr

<https://dergipark.org.tr/tr/pub/kefdergi>



KASTAMONU ÜNİVERSİTESİ KASTAMONU UNIVERSITY
KASTAMONU EĞİTİM DERGİSİ KASTAMONU EDUCATION JOURNAL

EDİTÖR KURULU | EDITORIAL BOARD

Prof. Dr. Abdullah Çağrı BİBER, Kastamonu Üniversitesi

Doç. Dr. Emine KARASU AVCI, Kastamonu Üniversitesi

Doç. Dr. Erkan YANARATEŞ, Kastamonu Üniversitesi

Doç. Dr. Ezgi MOR, Kastamonu Üniversitesi

Doç. Dr. Gökhan KAYA, Kastamonu Üniversitesi

Prof. Dr. Hüseyin YOLCU, Kastamonu Üniversitesi

Doç. Dr. İbrahim KEPÇEOĞLU, Kastamonu Üniversitesi

Prof. Dr. İlhan ÖZGÜL, Kastamonu Üniversitesi

Dr. Öğr. Üyesi İsmail YILDIZ, Kastamonu Üniversitesi

Doç. Dr. Mehmet Koray SERİN, Kastamonu Üniversitesi

Doç. Dr. Melike FAİZ, Kastamonu Üniversitesi

Dr. Murat KONUK, Kastamonu Üniversitesi

Doç. Dr. Mustafa Öztürk AKCAOĞLU, Kastamonu Üniversitesi

Dr. Öğr. Üyesi Sema KARA, Kastamonu Üniversitesi

Doç. Dr. Sevcin CANDAN HELVACI, Kastamonu Üniversitesi



Kastamonu Eğitim Dergisi

Yıl:2025 Cilt:33 No:3

Kastamonu Education Journal

Year: 2025 Volume: 33 Issue:3

Kastamonu Eğitim Dergisi Uluslararası Bilimsel Hakemli
Dergidir.

Ocak-Nisan-Temmuz-Ekim Aylarında yılda 4 defa çevrimiçi olarak yayınlanır.

Taranmakta olduğumuz dizinler:

TR Dizin ULAKBİM		CrossRef	
H.W. Wilson Education Full Text		Google Scholar	
EBSCO Education Source		Index Copernicus	
Education Research Complete		ERIH PLUS	
SOBIAD		Cite Factor	
Türk Eğitim İndeksi		EBSCO- The Belt and Road Initiative Reference Source	

Kastamonu Üniversitesi
Kastamonu Eğitim Dergisi





| Research Article / Araştırma Makalesi |

Language Preferences of Bilingual/Multilingual African International Students

İki/Çok Dilli Afrikalı Uluslararası Öğrencilerin Dil Tercihleri

Nazik Müge TEKİN¹, Erol TOPAL²

Keywords

1. Bilingualism
2. Multilingualism
3. Africa
4. Language policy
5. Language preferences

Anahtar Kelimeler

1. İkidillilik
2. Çokdillilik
3. Afrika
4. Dil politikası
5. Dil tercihleri

Received/Başvuru Tarihi

30.01.2025

Accepted / Kabul Tarihi

25.07.2025

Abstract

Purpose: The aim of this study is to determine the language preferences of African bilingual/multilingual university students in their sociocultural, daily, and religious lives. Additionally, the study will determine the effect of demographic characteristics (country, gender, and religion) of African bi/multilingual students participating in the study on their language preferences in the specified areas and reveal the similarities and differences in these preferences based on demographic factors with their reasons.

Design/Methodology/Approach: The “correlational survey model” was used to examine the relationship between the variables of the language preferences of African bilingual/multilingual students in different areas. The study sample was 31 international students randomly selected from bilingual/multilingual African students studying at Kastamonu University. First, demographic information of the participants was obtained with the forms prepared for data collection; then, 45 visuals related to sociocultural life, daily life, and religious life were presented to the participants and it was determined in which language they conceptualized the visual. Basic statistical techniques were employed to analyze the data, and the relationship between demographic characteristics and language preferences was tabulated.

Findings: The findings indicate that the language preferences of African bilingual and multilingual students are significantly influenced by their historical backgrounds, cultural identities, and sociopolitical environments. It was concluded that French, English, and Portuguese are the dominant languages in sociocultural and daily contexts. Both genders prefer global languages in sociocultural settings but have differing preferences in daily life. Among Muslim participants, Arabic is preferred, while Christian participants tend to favor Turkish for Islamic terms. Local languages are less preferred overall based on country and gender but are more commonly chosen for religious word choices.

Highlights: The analysis concluded that global languages, notably French and English, exhibit significant dominance in sociocultural interactions and everyday communication. In contrast, Arabic holds a prominent position primarily within religious contexts. Furthermore, it was apparent that local languages are utilized relatively infrequently. Turkish was predominantly favored in both religious and sociocultural contexts. Notable variations in language preferences are observed based on gender and religious affiliations. It was observed that female participants presented a broader language profile.

Öz

Çalışmanın amacı: Afrikalı iki/çok dilli üniversite öğrencilerinin sosyokültürel, günlük ve dinî hayatlarındaki dil tercihlerini belirlemektir. Ayrıca çalışmaya katılan Afrikalı iki/çok dilli öğrencilerin demografik özelliklerinin (ülke, cinsiyet ve din) belirtilen alanlardaki dil tercihlerine etkisini tespit ederek bu tercihlerin demografik özellikler bakımından benzerlik ve farklarını sebepleriyle ortaya koymaktır.

Materyal ve Yöntem: Çalışmada Afrikalı iki/çok dilli öğrencilerin farklı alanlarda dil tercihlerinin değişkenler arasında ilişkilerine bakılacağından “ilişkisel tarama modeli” kullanılmıştır. Çalışmanın örneklemini Kastamonu Üniversitesi’nde öğrenim gören, iki/çok dilli Afrikalı öğrenciler arasından rastgele seçilen 31 uluslararası öğrencidir. Veri toplamak amacıyla hazırlanan formlarla öncelikle katılımcıların demografik bilgileri alınmış; daha sonra katılımcılara, sosyokültürel hayat, günlük hayat ve dini hayat ile ilgili 45 görsel sunularak görseli hangi dilde kavramsallaştırdığı belirlenmiştir. Verilerin analizinde, temel istatistiksel teknikler kullanılmış, demografik özelliklerle dil tercihleri arasındaki veriler tablolatırılmıştır.

Bulgular: Bulgular, Afrikalı iki/çok dilli öğrencilerin dil tercihlerini tarihsel, kültürel ve sosyopolitik bağlamların şekillendirdiğini göstermektedir. Fransızca, İngilizce ve Portekizcenin sosyokültürel ve günlük dil seçimlerinde baskın olduğu görülmüştür. Katılımcıların cinsiyetine göre sosyokültürel hayatta her iki cinsiyet de küresel dilleri tercih ederken, günlük dil tercihleri farklılık göstermektedir. Dinî inançlara göre ise Müslüman katılımcılar arasında Arapça hâkimken, Hristiyan katılımcılar özellikle İslâmiyet ile ilgili kelimelerde Türkçeyi tercih etmektedir. Ayrıca, katılımcıların ülke ve cinsiyetlerine göre yerel diller daha az tercih edilmekte, ancak dini inanışlarına göre kelime tercihlerinde yerel diller daha fazla kullanılmaktadır.

Önemli Vurgular: Fransızca ve İngilizce gibi küresel dillerin sosyokültürel ve günlük hayatta baskın olduğu, dini bağlamda ise Arapçanın öne çıktığı tespit edilmiştir; yerel dillerin genel anlamda düşük kullanım oranına sahip olduğu anlaşılmıştır. Türkçenin hem dini hem de sosyokültürel bağlamlarda belirgin bir şekilde tercih edildiği dikkat çekmiştir. Cinsiyet ve dini inançlara göre dil tercihlerinde ise dikkat çekici farklılıklar gözlenmiştir. Kadın katılımcıların daha geniş bir dil profili sunduğu görülmüştür.

¹ Corresponded Author, TÖMER, Kastamonu University, Kastamonu, Türkiye; <https://orcid.org/0000-0001-9046-4340>

² Faculty of Education, Department of Social Sciences and Turkish Language Teaching Department of Turkish Education, Kastamonu University, Kastamonu, Türkiye, <https://orcid.org/0000-0002-9773-0389>

INTRODUCTION

Phenomena such as globalization, migration, and colonialism have accelerated cultural and linguistic interactions worldwide, making multilingualism and cultural diversity more visible realities. Colonialism has profoundly influenced both individuals' language use and communities' identity construction processes throughout history. The pressure exerted by colonial powers on local languages and the official recognition of colonial languages has led to the emergence of linguistic diversity and multilingual structures in many societies. While local languages strive to survive as carriers of cultural identity, global languages such as French, English, and Portuguese have achieved dominance in education, administration, and commerce. Kamwangamalu (2000) observes that in the post-colonial period, former colonial languages like French and English continue to play dominant roles and are still recognized as official and prestigious languages. Similarly, Mwaniki (2011) notes the significant influence of French and English in education, commerce, and international communication. This situation has compelled individuals to navigate between languages to express their identities and adapt to various sociocultural contexts.

The cultural and linguistic impacts of colonialism continue to remain fundamental elements of language policies and social dynamics in many countries today, rather than solely being confined to a historical reality. In post-colonial societies, the positioning of former colonial languages as official and prestigious has led individuals to prioritize these languages in their daily, academic, and religious lives. Conversely, the marginalization of local languages in certain aspects of social life has emerged as a threat to cultural and linguistic sustainability. In this context, bilingualism or multilingualism transcends being merely a tool of communication, evolving into a dynamic space where individuals negotiate their identities and express their sociocultural affiliations. Understanding the complex nature of multilingualism in the post-colonial era is of critical importance for fostering social cohesion and developing effective language policies.

There are various studies on how individuals' language use is shaped by social and cultural contexts. Grosjean (2010) emphasizes that the language use practices of bilingual individuals are deeply related not only to their language skills but also to their social identities, cultural affiliations, and the contexts they are in. The studies conducted by Wei (2000), Bhatia, and Ritchie (2013) explore how multilingualism influences individuals' social lives. They explain how people make language choices in various contexts and highlight the impact of social, cultural, and personal factors on these language preferences.

In addition, studies on the relationship between language and identity have made significant contributions to this field. Pavlenko and Blackledge (2004) state that multilingual individuals engage in identity negotiations across different social contexts, with language serving as a crucial tool in these processes. Norton (2013) examines the connection between language learning and identity construction, highlighting that language is not merely a means of communication but also an active component in the formation of identity. In light of these studies, how the language use of African bilingual or multilingual individuals contributes to their cultural and social identities can be explored.

Language use in a sociocultural context has also been studied in relation to globalization and linguistic change. Blommaert (2010) discusses the impact of globalization on the linguistic practices of multilingual individuals, analyzing how individuals move between languages as they move between different cultural and linguistic environments. This perspective is particularly important for understanding the impact of African students' life experiences in different countries on their language use.

Studies on the interaction between religion and language have shown that language use plays an important role in religious practices. Spolsky (2003) and Omoniyi & Fishman (2006) offer various sociolinguistic perspectives on how language is used in religious practices. The languages multilingual individuals in Africa prefer for their religious worship and daily religious practices can be analyzed in the context of language-religion interaction. In addition, Mazrui & Mazrui (1998), who examined the relationships between language and administration in the African context, and Mufwene (2001), who analyzed linguistic diversity in Africa, believe that the linguistic ecology of the countries these individuals come from can help understand the impact of language use on their language use.

In this context, understanding the functions of language use in sociocultural contexts, language preferences in daily interactions, and the role of language in religious practices can make significant contributions to multilingualism studies and language-identity relations. Therefore, it was deemed necessary to conduct a study examining the language preferences of African bilingual/multilingual students in higher education in Türkiye in terms of sociocultural, daily, and religious life. In response to this need, the study aims to conduct a thorough examination from the perspectives of language acquisition, cultural identity, and sociolinguistics to understand the factors influencing the language preferences of these individuals. It is believed that this study can provide an in-depth understanding of the linguistic practices of this group by examining the language use of African bilingual or multilingual university students in cultural, daily, and religious contexts. It is hoped that the study will reveal the dynamics that shape the linguistic preferences of multilingual individuals by analyzing how the language acquisition processes are affected by the demographic characteristics of individuals. In addition, it is expected to make significant contributions to the role of language in social structure by examining the relationship between the language use of African individuals and cultural identity, social belonging and religious practices. In this regard, it is believed that the study will offer unique contributions to academic literature by providing new data on the relationship between language and identity from both linguistic and sociocultural perspectives.

The Effects of Colonialism on Language and Culture in Africa

Africa, with its rich culture and history, is one of the most remarkable regions of the world. However, starting from the 15th century, the colonial policies of European states brought about profound transformations in the social structure of the continent. During this period, it can be argued that the fields of language, culture, and religion were particularly affected by colonial policies.

Language is one of the most significant elements that shape a society's identity. However, colonialists used language policies as a tool to control the indigenous people and impose their own culture. For example, in Mali under French colonial rule, French was adopted as the official language and local languages lost their importance. This situation led to the indigenous people alienate from their cultural identity (Kavak, 2021). The influence of Arabic in West Africa is also noteworthy. Arabic entered the region, especially through trade routes and played an important role in the spread of Islam. However, European colonialism interrupted this spread and caused linguistic fragmentation. This situation resulted in the damage of communication and unity among local communities (İmamaliyeva, 2023; Yiğit and Soumana, 2019).

African culture was subjected to significant pressure during the colonial period. Colonizers undermined local traditions and forms of art, imposing a Eurocentric cultural perspective on Africa. For example, in Nigeria, missionary schools were established to spread Western values, replacing local cultures with Western-centered cultures (Kavak, 2021). On the other hand, the spread of Islamic law and literature played an important role in fostering cultural unity (Yiğit and Soumana, 2019). It can be said that Arabic and Islamic culture in West Africa had a lasting impact on local communities and played a unifying role among the peoples of the region.

The effects of colonialism on religion were felt through missionary activities. The spread of Christianity was a tool used by colonists to control local people. In Algeria, French colonists tried to control society by attacking the religious symbols of the local people. However, these policies often faced resistance and led to a strengthening of religious identities (Karaca, 2024). On the other hand, Islam is thought to have served as a tool for cultural and religious independence in various regions of Africa, acting as a significant source of resistance against Western colonial policies.

Colonialism in Africa left significant impacts on language, culture, and religion. While colonial powers attempted to weaken local identities and impose their own cultures, it can be argued that African communities resisted this pressure and succeeded in preserving their cultural and religious identities. This resistance forms the foundation of the diversity and richness that Africa has today. There is a prevailing belief that the colonial process continues to have a strong influence on Africa's historical and cultural structure, as well as the continent's unique identity.

The Concept of Bilingualism and Bilingualism in Africa

In the changing world order, bilingualism and multilingualism represent a reality on both individual and societal levels for more than half of the world's population (Akıncı, 2016, p.205). It can be said that migrations and colonial activities have played a significant role in the emergence of bilingualism.

Bilingualism is a matter that should be considered separately as an individual and a society. There are different views on the definition of this concept. There are different opinions on the definition of bilingualism, which can generally be defined as the ability to use more than one language. Bloomfield (1933, p.56) defines bilingualism as an individual being able to understand and speak two languages at a level equivalent to that of a native speaker. Haugen (1953, p.7) and Macnamara (1967) opposed this view and argued that the important point is that it is sufficient to produce meaningful linguistic production in both languages. Mohanty (1994, p.13) emphasized the individual's ability to communicate both personally and socially with speakers of two or more languages.

Since it is difficult to provide a general and satisfactory definition of the concept of bilingualism, many linguists (Weinreich, 1953; Ervin and Osgood, 1954; Fishman, 1965; Macnamara, 1967, etc.) have developed descriptive typologies explaining various types of bilingualism. Bilingualism categorizes individuals' level of proficiency in two languages, their ages of acquisition, their skills in these languages and the relationships between these skills, as well as the positive or negative effects of these languages on each other. In this context, there are many different types of concepts of bilingualism. With these differences, it can be said that the concept of bilingualism is based on a general distinction between individual bilingualism and societal bilingualism.

Within the scope of societal bilingualism, various factors such as the politics, history, and adopted religious beliefs of the country play an influential role in a society becoming bilingual. These factors emerge as a result of the society's own dynamics and internal relationships, paving the way for the formation of hybrid languages such as Pidgin, Creole, and other mixed languages that previously did not exist (Süverdem & Ertek, 2020, p.187).

The African continent is considered one of the richest regions in the world in terms of linguistic diversity. The ethnic structure of the continent, its colonial past, and its multilingual society have led to the formation of different types of bilingualism. The types of bilingualism observed in Africa differ depending on how individuals acquire and use the languages available to them, as well as the social contexts in which they are employed. For example, in Africa, many people speak a local language (e.g., Yoruba, Zulu, Swahili) at home while learning and using colonial languages (e.g., English, French) for official matters. The use of both languages for different purposes may indicate the presence of "Mass/Compulsory Bilingualism" in Africa. Tosi (1982) used the concept of

mass bilingualism to describe the situation of ethnic groups living within the borders of a state who, often unwillingly, are forced to become bilingual in order to sustain their existence.

In many regions of Africa, individuals have learned their second language (L2) in dependence on their first language (L1) in the post-colonial period. For instance, a student learns English based on their local language, using their native language to make sense of English during the learning process. This type of bilingualism is more commonly observed in systems with access to education (Hamers & Blanc, 2000). This form of bilingualism is referred to as "Subordinate Bilingualism." Deshays (1990, p.30) states that this concept describes a situation where the second language is learned and experienced solely through the native language. Subordinate bilingual individuals attempt to express words in the less dominant language using the vocabulary of the more proficient language. This process occurs as the dominant language exerts influence over the other, resulting in word transfer and leading to what is known as code-switching. It is believed that this characteristic also affects the language choices of subordinate bilingual individuals regarding vocabulary in different domains.

As previously mentioned, bilingualism is both an individual and societal phenomenon. In this context, bilingualism in Africa emerges not only as an individual trait but also as a societal characteristic. Many African countries have adopted colonial languages as official languages. However, these languages are often used alongside local languages. For example, while English is the official language in Nigeria, languages such as Hausa, Igbo and Yoruba are spoken by large communities. This demonstrates that both societal and individual forms of bilingualism coexist in Africa.

Bilingualism in Africa, as mentioned, manifests itself in various forms depending on how individuals and societies learn and use languages. The factors affecting bilingualism in Africa stem not only from individual language learning processes but also from the historical and social structure of the continent. In this context, the diversity and dynamic structure of bilingualism in Africa offers an important field of study for linguistics and language teaching research.

METHOD/MATERIALS

Research Design

In the study, the "correlational screening model" was used to identify the word preferences of bilingual or multilingual African international university students in sociocultural, daily, and religious life and to examine the relationships between these preferences and various variables. "The correlational screening model is a research model that aims to determine the existence or degree of change between two or more variables." (Karasar, 2014, p.81). This approach aims to provide a more comprehensive analysis of the connections and differences in language use. The study aims to determine which languages students prefer through visual stimuli and to analyze these preferences in relation to demographic variables. Therefore, in terms of both determining existing linguistic behaviors and explaining the relationships among these behaviors, the correlational survey model offers a highly functional and appropriate methodological approach.

Research Population/Sample and Study Group

The research population consists of African bilingual/multilingual international students. The sample includes 31 African bilingual/multilingual international students who participated voluntarily, studying at Kastamonu University. The number of participants by country is as follows: 10 from Chad, 8 from Somalia, 3 from Morocco, 3 from Guinea-Bissau, 1 from Equatorial Guinea, 1 from Eritrea, 1 from Gabon, 1 from Cameroon, 1 from Mali, 1 from Nigeria, and 1 from Tunisia. Among these participants, 7 are female, and 24 are male. In terms of religious affiliation, 4 participants are Christian, while 27 are Muslim.

Data Collection Tool

In this study, a demographic information form was first developed to identify participants' demographic details (country, gender, and religion), and the necessary information was collected from the participants. Then, to determine participants' language preferences in sociocultural, daily, and religious contexts, a presentation consisting of 45 visuals (15 for each context) was shown. Participants were asked to write down their language preference for each visual within 5 seconds. The time limit was kept short to determine in which language the participant's visualization takes place when they first see the visuals.

Data Analysis

In this study, a demographic information form was first developed to identify participants' demographic details (country, gender, and religion), and the necessary information was collected from the participants. Then, to determine participants' language preferences in sociocultural (ceremony, dance, traditional dress, family, painter, cinema, classroom, concert, festival, tower, pianist, statue, flag, bridge, rally), daily (breakfast, sports, bus, cleaning, cafe, house, cat, dog, lesson, traffic, shopping, store, park, friend, coffee), and religious (mosque, church, green, Kaaba, grave, coffin, take, cross, rosary, imam, priest, prayer, Christmas, hijab, ablution) contexts, a presentation consisting of 45 visuals (15 for each context) was shown. In the selection of visuals related to daily, sociocultural and religious life in the study, criterion was to include representative elements that the participants frequently encountered in different areas of life and that touched on their cultural and individual experiences. In this

context, the visuals were selected to reveal how students conceptualized language in various social contexts; care was taken to ensure that they were of a quality that could reflect how individuals' language preferences were shaped not only in academic but also in social and faith-based interactions. In this way, it was aimed to observe linguistic associations in a more natural and meaningful way. Participants were asked to write down their language preference for each visual within 5 seconds. The time limit was kept short to determine in which language the participant's visualization takes place when they first see the visuals.

The analysis of the data obtained in this study was conducted using descriptive analysis, which is one of the quantitative methods. Descriptive analysis is the process of systematically summarizing and organizing data to identify patterns, trends, and relationships within a dataset (Loeb et al., 2017). The data analysis was structured to address the research questions and designed to determine participants' language preferences in sociocultural, daily, and religious life. Basic statistical techniques were used in the analysis of the obtained data. In the first stage, descriptive statistics were tabulated to summarize the preferences of the participants according to their demographic characteristics, and then the numerical data and ratios derived from tables were interpreted and analyzed.

The purpose of the study is to examine the language preferences of African bilingual/multilingual university students in their sociocultural, daily and religious lives and to determine the effect of their demographic characteristics on their language preferences. In order to achieve this purpose, the question of "What is the effect of the demographic characteristics of African bilingual/multilingual students on their language preferences?" was sought in general. Additionally, the study addresses the following sub-questions:

1. What is the impact of participants' countries on their language preferences for words related to sociocultural, daily, and religious life?
2. What is the impact of participants' genders on their language preferences for words related to sociocultural, daily, and religious life?
3. What is the impact of participants' religious beliefs on their language preferences for words related to sociocultural, daily, and religious life?

Findings and Discussion

In this section, the language preferences of 31 bilingual/multilingual African participants regarding sociocultural, daily, and religious life-related words were analyzed based on their demographic characteristics (country, gender, and religion). The numerical data obtained were tabulated and interpreted accordingly.

Table 1. Participants' Language Preferences Related to Sociocultural Life-related Words According to Their Countries

	<i>Arabic</i>	<i>Bambara</i>	<i>Fang</i>	<i>French</i>	<i>English</i>	<i>Spanish</i>	<i>Creole</i>	<i>Malay</i>	<i>Moru</i>	<i>Portuguese</i>	<i>Somali</i>	<i>Tigrinya</i>	<i>Turkish</i>	<i>Yoruba</i>
Chad	24	0	0	118	0	0	0	0	0	0	0	0	8	0
Equatorial Guinea	0	0	1	2	3	7	0	0	0	0	0	0	2	0
Eritrea	5	0	0	0	9	0	0	0	0	0	0	1	0	0
Morocco	17	0	0	17	9	0	0	0	0	0	0	0	2	0
Gabon	0	0	1	13	0	0	0	0	0	0	0	0	1	0
Guinea-Bissau	0	0	0	7	4	6	17	0	0	2	0	0	9	0
Cameroon	0	0	0	3	11	0	0	0	0	0	0	0	1	0
Mali	0	1	0	13	0	0	0	0	0	0	0	0	1	0
Nigeria	0	0	0	0	13	0	0	0	0	0	0	0	1	1
Somalia	1	0	0	0	74	0	0	0	0	0	28	0	14	0
Tunisia	4	0	0	7	2	0	0	0	0	0	0	0	2	0

When Table 1 is examined, the numerical and proportional values of participants' language preferences for sociocultural life-related words based on their countries are observed. For the Chadian participants, the numerical values are French 118, Arabic 24, and Turkish 8; the proportional values are French 78.66%, Arabic 16%, and Turkish 5.33%. For Equatorial Guinean participants, the numerical values are Spanish 7, English 3, French 2, Turkish 2, and Fang 1; the proportional values are Spanish 46%, English 20%, French 13.33%, Turkish 13.33%, and Fang 6.66%. For the Eritrean participant, the numerical values are Arabic 5, English 9, and Tigrinya 1; the proportional values are Arabic 33.33%, English 60%, and Tigrinya 6.66%. For Moroccan participants, the numerical values are Arabic 17, French 17, English 9, and Turkish 2; the proportional values are Arabic 37.77%, French 37.77%, English 20%, and Turkish 4.44%. For the Gabonese participant, the numerical values are French 13, Fang 1, and Turkish 1; the proportional values are French 86.66%, Fang 6.66%, and Turkish 6.66%. For Guinea-Bissauan participants, the numerical values are Creole 17, Turkish 9, French 7, Spanish 6, English 4, and Portuguese 1; the proportional values are Creole 37.7%, Turkish 20%, French 15.5%, Spanish 13.33%, English 8.88%, and Portuguese 4.44%. For the Cameroonian participant, the numerical values are English 11, French 3, and Turkish 1; the proportional values are English 73.33%, French 20%, and Turkish 6.66%. For the Malian

participant, the numerical values are French 13, Bambara 1, and Turkish 1; the proportional values are French 86.66%, Bambara 6.66%, and Turkish 6.66%. For the Nigerian participant, the numerical values are English 13, Turkish 1, and Yoruba 1; the proportional values are English 86.66%, Turkish 6.66%, and Yoruba 6.66%. For Somali participants, the numerical values are English 74, Somali 28, Turkish 17, and Arabic 1; the proportional values are English 61.66%, Somali 23.33%, Turkish 14.16%, and Arabic 0.83%. For Moroccan participants, the numerical values are French 7, Arabic 4, English 2, and Turkish 2; the proportional values are French 46.66%, Arabic 26.66%, and English and Turkish 13.33%.

When the language preferences of the participants in sociocultural life are examined according to their countries; French stands out as the dominant language in former French colonies such as Chad (78.66%), Gabon (86.66%), Mali (86.66%) and Morocco (37.77%), while English has been the primary language in countries such as Nigeria (86.66%), Cameroon (73.33%) and Somalia (61.66%). Arabic demonstrates a strong position in religious and cultural contexts in countries like Morocco (37.77%), Eritrea (33.33%), and Chad (16%). The generally low usage rates of local languages (Fang, Bambara, Tigrinya) reflect the dominance of global languages in social communication. Additionally, the preference for Turkish in countries such as Guinea-Bissau (20%), Somalia (14.16%), and Morocco (13.33%) can be seen as an indicator of Türkiye's educational and cultural influence.

Table 2. Language Preferences of Participants in Daily Life-related Words According to Their Countries

	Arabic	Bambara	Fang	French	English	Spanish	Creole	Malay	Moru	Portuguese	Somali	Tigrinia	Turkish	Yoruba
Chad	101	0	0	42	0	0	0	0	0	0	0	0	7	0
Equatorial Guinea	0	0	1	1	2	5	0	0	0	1	0	0	5	0
Eritrea	5	0	0	0	7	0	0	0	0	0	0	2	1	0
Morocco	29	0	0	12	2	0	0	0	0	0	0	0	2	0
Gabon	0	0	1	10	0	0	0	0	0	0	0	0	4	0
Guinea-Bissau	0	0	0	0	0	3	6	0	0	25	0	0	11	0
Cameroon	0	0	0	12	2	0	0	0	0	0	0	0	1	0
Mali	0	0	0	13	0	0	0	0	0	0	0	0	2	0
Nigeria	0	0	0	0	8	0	0	5	1	0	0	0	1	0
Somalia	0	0	0	0	27	0	0	0	0	0	78	0	15	0
Tunisia	6	0	0	5	2	0	0	0	0	0	0	0	2	0

When Table 2 is examined, the numerical and proportional values of participants' language preferences for daily life-related terms based on their countries are observed. For the Chadian participants, the numerical values are Arabic 101, French 42, and Turkish 7; the proportional values are Arabic 67.33%, French 28%, and Turkish 4.66%. For the Equatorial Guinean participants, the numerical values are Spanish 5, Turkish 5, English 2, Fang, French, and Portuguese 1; the proportional values are Spanish 33.33%, Turkish 33.33%, English 13.30%, Fang, French, and Portuguese 6.66%. For the Eritrean participants, the numerical values are English 7, Arabic 5, Tigrinia 2, and Turkish 1; the proportional values are English 46.66%, Arabic 33.33%, Tigrinia 13.33%, and Turkish 6.66%. For the Moroccan participants, the numerical values are Arabic 29, French 12, English, and Turkish 2; the proportional values are Arabic 64.44%, French 26.66%, English and Turkish 4.44%. For the Gabonese participants, the numerical values are French 10, Turkish 4, and Fang 1; the proportional values are French 66.66%, Turkish 26.66%, and Fang 6.60%. For the Guinea-Bissau participants, the numerical values are Portuguese 25, Turkish 11, Creole 6, and Spanish 3; the proportional values are Portuguese 55.55%, Turkish 24.44%, Krol 13.33%, and Spanish 6.66%. For the Malian participants, the numerical values are French 13 and Turkish 12; the proportional values are French 86.66% and Turkish 13.33%. For the Nigerian participants, the numerical values are English 8, Malay 5, Moru 1, and Turkish 1; the proportional values are English 53.33%, Malay 33.33%, Moru and Turkish 6.66%. For the Cameroonian participant, the numerical values are French 12, English 2, and Turkish 1; the proportional values are French 80%, English 13.33% and Turkish 6.66%. For the Somali participants, the numerical values are Somali 78, English 27, and Turkish 15; the proportional values are Somali 65%, English 22.50%, and Turkish 12.50%. Finally, the numerical values for the Tunisian participants are Arabic 6, French 5, English 2, and Turkish 2; the proportional values are calculated as Arabic 40%, French 33.33%, English, and Turkish 13.33%.

When examining the participants' daily language preferences by country, Arabic stands out as the dominant language among participants from Chad (67.33%), Morocco (64.44%), and Tunisia (40%). French is strongly preferred in former French colonies such as Gabon (66.66%), Cameroon (80%), and Mali (86.66%). Local languages maintain significance in countries like Somalia, where Somali is used by 65%, and Nigeria, where Malay is spoken by 33.33%, indicating their role as carriers of cultural identity. Portuguese continues its dominance in Guinea-Bissau (55.55%), while English is preferred as an international communication language in countries like Eritrea (46.66%) and Nigeria (53.33%). The prominence of Turkish among groups in Somalia (12.50%), Guinea-Bissau (24.44%), and Equatorial Guinea (33.33%) highlights Türkiye's cultural and diplomatic influence in Africa.

Table 3. Language Preferences of Participants in Religion-related Words According to Their Countries

	Arabic	Bambara	Fang	French	English	Spanish	Creole	Malay	Moru	Portuguese	Somali	Tigrinia	Turkish	Yoruba
Chad	103	0	0	42	0	0	0	0	0	0	0	0	5	0
Equatorial Guinea	0	0	0	0	0	5	1	0	0	1	0	0	8	0
Eritrea	11	0	0	0	3	0	0	0	0	0	0	1	0	0
Morocco	35	0	0	1	9	0	0	0	0	0	0	0	0	0
Gabon	0	0	0	7	0	0	0	0	0	0	0	0	8	0
Guinea-Bissau	0	0	0	1	0	0	4	0	0	16	0	0	24	0
Cameroon	0	0	0	6	1	0	0	0	0	0	0	0	8	0
Mali	0	0	0	12	0	0	0	0	0	0	0	0	3	0
Nigeria	9	0	0	0	5	0	0	1	0	0	0	0	0	0
Somalia	36	0	0	0	33	0	0	0	0	0	47	0	4	0
Tunisia	11	0	0	3	1	0	0	0	0	0	0	0	0	0

As seen in Table 3, the numerical values of participants' language preferences for words related to religious life are presented based on their countries. For the Chadian participants, the numerical values are Arabic 103, French 42, and Turkish 5; proportional values are Arabic 67.33%, French 28%, and Turkish 4.66%. For the Equatorial Guinean participants, the numerical values are Turkish 8, Spanish 5, Creole and Portuguese 1; proportional values are Spanish 33.33%, Turkish 33.33%, English 13.30%, Fang, French, and Portuguese 6.66%. For the Eritrean participants, the numerical values are Arabic 11, English 3, and Tigrinia 1; proportional values are English 46.66%, Arabic 33.33%, Tigrinia 13.33%, and Turkish 6.66%. For the Moroccan participants, the numerical values are Arabic 35, English 9, and French 1; The proportional values were determined as Arabic 64.44%, French 26.66%, English, and Turkish 4.44%. For the Gabonese participants, the numerical values were French 7 and Turkish 8; the proportional values were French 66.66%, Turkish 26.66% and Fang 6.60%. For the Guinea-Bissau participants, the numerical values were Turkish 24, Portuguese 16, Creole 4 and French 1; the proportional values were Portuguese 55.55%, Turkish 24.44%, Creole 13.33% and Spanish 6.66%. For the Malian participants, the numerical values were French 12 and Turkish 3; the proportional values were French 86.66% and Turkish 13.33%. For the Nigerian participants, the numerical values were Arabic 9, English 5 and Malay 1; the proportional values were English 53.33%, Malay 33.33%, Moru and Turkish 6.66%. For the Cameroonian participant, the numerical values were 8 for Turkish, 6 for French, and 1 for English; the proportional values were 80% for French, 13.33% for English, and 6.66% for Turkish. For the Somali participant, the numerical values were 36 for Somali, 33 for English, and 4 for Turkish; the proportional values were 65% for Somali, 22.50% for English, and 12.50% for Turkish. Finally, for the Tunisian participant, the numerical values were 11 for Arabic, 3 for French and 1 for English; and the proportional values were 73.33% for Arabic, 20% for French, and 6.67% for English.

Table 4. Language Preferences of Participants in Sociocultural-related Words According to Their Genders

	Arabic	Bambara	Fang	French	English	Spanish	Creole	Malay	Moru	Portuguese	Somali	Tigrinia	Turkish	Yoruba
Kadın	14	0	1	21	53	9	4	0	0	1	13	0	18	1
Erkek	37	1	1	159	72	4	13	0	0	1	15	1	26	0

Table 4 presents the numerical values of participants' language preferences for words related to sociocultural life based on gender. It is seen that the numerical values for female participants are 53 for English, 21 for French, 18 for Turkish, 14 for Arabic, 13 for Somali, 9 for Spanish, 4 for Creole, 1 for Fang, Portuguese, and Yoruba. The numerical rates for female participants are 39.25%, 15.55%, 13.33% for Turkish, 10.37% for Arabic, 9.62% for Somali, 6.66% for Spanish, 1% for Portuguese, and 0.74% for Fang and Yoruba. The numerical values for male participants are 159 for French, 72 for English, 37 for Arabic, 26 for Turkish, 15 for Somali, 13 for Creole, 13 for Spanish, 4 for Bambara, Fang, Portuguese, and Tigrinia. For male participants, the proportional values were determined as French 48.18%, English 21.81%, Arabic 11.21%, Turkish 7.87, Somali 4.54%, Creole 3.93%, Spanish 1.21%, Bambara, Fang, Portuguese and Tigrinia 0.30%.

When examining the language preferences related to sociocultural life based on participants' gender, it is observed that English is the most preferred language among female participants, while French (15.55%), Turkish (13.33%), and Arabic (10.37%) are less frequently chosen. Among male participants, French (48.18%) stands out as the dominant language, followed by English (21.81%) and Arabic (11.21%). The usage rate of Turkish is higher among females (13.33%) compared to males (7.87%), indicating that Turkish stands out as a significant language preference for both groups. It is observed that local languages (Somali, Creole, Fang, Yoruba, etc.) are preferred to a limited extent among male and female participants. Overall, while language preferences differ between genders, English and French remain dominant for both groups. This reflects the strong influence of global languages in sociocultural contexts regardless of gender.

Table 5. Language Preferences of Participants in Daily Life-related Words According to Their Genders

	Arabic	Bambara	Fang	French	English	Spanish	Creole	Malay	Moru	Portuguese	Somali	Tigrinia	Turkish	Yoruba
Kadın	23	0	1	15	20	6	2	5	1	9	33	0	20	0
Erkek	118	0	1	80	30	2	4	0	0	17	45	2	31	0

In Table 5, the numerical values of participants' language preferences for words related to daily life are presented based on their gender. Upon examining the table, the numerical values for female participants are as follows: Somali 33, Arabic 23, English 20, Turkish 20, French 15, Portuguese 9, Spanish 6, Malay 5, Creole 2, and Fang and Moru 1. The proportional values for female participants are calculated as Somali 24.44%, Arabic 17.03%, English 14.81%, Turkish 14.81%, French 11.11%, Portuguese 6.66%, Spanish 4.44%, Malay 3.70%, Creole 1.48%, Fang and Moru 0.74%. The numerical values for male participants are Arabic 118, French 80, Somali 45, Turkish 31, English 30, Portuguese 17, Creole 4, Spanish 2, Turkish 2 and Fang 1. The proportional values for male participants were determined as Arabic 35.75%, French 24.24%, Somali 13.63%, Turkish 9.39%, English 9.09%, Portuguese 5.15%, Spanish 0.60%, Tigrinia 0.60% and Fang 0.30%.

When examining the language preferences of participants based on gender in daily life, Somali (24.44%) stands out as the most preferred language among female participants, followed by Arabic (17.03%), English (14.81%), and Turkish (14.81%) as the second and third most preferred languages, respectively. Among male participants, Arabic (35.75%) stands out as the dominant language, while French (24.24%) and Somali (13.63%) are also significant choices. Turkish is preferred by both groups at similar rates (14.81% among females and 9.39% among males). Portuguese, Spanish, Creole, and other local languages show limited usage in both groups. In this context, it can be understood that participants' language preferences in daily life may vary based on gender. However, languages such as Arabic, French, and Somali demonstrate a strong overall influence. While female participants exhibit a broader variety of language preferences, Arabic and French have a more pronounced dominance among male participants. The fact that Turkish has become a distinct preference among both groups is a notable result.

Table 6. Language Preferences of Participants in Religion-related Words According to Their Genders

	Arabic	Bambara	Fang	French	English	Spanish	Creole	Malay	Moru	Portuguese	Somali	Tigrinia	Turkish	Yoruba
Kadın	57	0	0	3	25	5	3	1	0	6	18	0	17	0
Erkek	148	0	0	69	27	0	2	0	0	11	29	1	43	0

In Table 6, the numerical values of participants' language preferences for words related to religious life are presented based on their gender. The numerical values for female participants are Arabic 57, English 25, Somali 28, Turkish 17, Portuguese 6, Spanish 5, French 3, Creole 3, and Malay 1. The proportional values for female participants are Arabic 42.22%, English 18.51%, Somali 13.33%, Turkish 12.59%, Portuguese 4.44%, Spanish 3.70%, French 2.22%, Creole 2.22%, and Malay 0.74%. The numerical values for male participants are Arabic 148, French 69, Turkish 43, Somali 29, English 27, Portuguese 11, Creole 2, and Tigrinia 1. For male participants, the proportional values were calculated as Arabic 44.84%, French 20.90%, Turkish 13.03%, Somali 8.78%, English 8.18%, Portuguese 3.33%, Creole 0.60% and Tigrinia 0.30%.

When the language preferences of the participants in religious life are examined according to their gender, Arabic (42.22%) is the most preferred language among female participants, while English (18.51%), Somali (13.33%) and Turkish (12.59%) are among the other preferred languages, respectively. Arabic (44.84%) stands out as the dominant language in terms of preference among male participants, while French (20.90%) and Turkish (13.03%) are also preferred with significant rates. It is evident that Arabic demonstrates a clear dominance among both female and male participants, while English and Somali are preferred at higher rates among women. Turkish, on the other hand, is chosen at similar rates by both genders (12.59% for women and 13.03% for men), which is a noteworthy observation. Portuguese, Spanish, Creole, and other local languages, on the other hand, show limited usage in this context. These findings suggest that Arabic plays a central role in the participants' language preferences in religious life regardless of gender, while Turkish stands out as a distinct choice for both groups. It is thought that female participants display a more diverse profile in their language preferences, whereas male participants tend to focus on dominant languages such as Arabic and French.

Table 7. Language Preferences of Participants in Sociocultural-related Words Based on Religious Beliefs

	Arabic	Bambara	Fang	French	English	Spanish	Creole	Malay	Moru	Portuguese	Somali	Tigrinia	Turkish	Yoruba
Christian	0	0	2	25	18	13	17	0	0	0	0	0	13	0
Muslim	51	1	0	155	107	0	0	0	0	0	28	1	31	1

In Table 6, the numerical values of participants' language preferences for sociocultural-related words based on their religious beliefs are presented. The numerical values for Christian participants are French 25, English 18, Creole 17, Spanish 13, Turkish 13, and Fang 2. The proportional values for Christian participants are French 27.77%, English 20%, Creole 18.88%, Spanish 14.44%, Turkish 14.44%, and Fang 2.22%. The numerical values for Muslim participants are French 155, English 107, Arabic 51, Turkish 31, Somali 28, Bambara, Tigrinia, and Yoruba 1. The proportional values for Muslim participants are French 41.33%, English 28.53%, Arabic 13.60%, Turkish 8.26%, Bambara, Tigrinia, and Yoruba 0.26%.

When examining language preferences for sociocultural life-related words based on participants' religious beliefs, French stands out as the most preferred language among Christian participants (27.77%), followed by English (20%), Creole (18.88%), Spanish (14.44%), and Turkish (14.44%) as other significant preferences. French (41.33%) is by far the dominant language among Muslim participants, while English (28.53%), Arabic (13.60%) and Turkish (8.26%) are the other preferred languages, respectively. While the influence of languages like Creole and Spanish is notable among Christian participants, the significant role of Arabic in religious contexts stands out among Muslim participants. Turkish is a prominent choice in both groups (14.44% and 8.26%, respectively). Based on the findings, it can be deduced that religious beliefs influence language preferences, with global languages such as French and English holding an important position in both Christian and Muslim communities. The noticeable presence of Turkish in both groups can be interpreted as a reflection of Türkiye's sociocultural and religious influence. Additionally, it is thought that the fact that Christian participants often learn concepts related to Islam in Turkish for the first time also plays a role in this preference.

Table 8. Language Preferences of Participants in Daily Life-related Words Based on Religious Beliefs

	Arabic	Bambara	Fang	French	English	Spanish	Creole	Malay	Moru	Portuguese	Somali	Tigrinia	Turkish	Yoruba
Christian	0	0	2	23	4	8	6	0	0	26	0	0	21	0
Muslim	141	0	0	72	46	0	0	5	1	0	78	2	30	0

Table 8 shows the numerical values of the participants' language preferences for daily life-related words based on their religious beliefs. The numerical values for Christian participants are Portuguese 26, French 23, Turkish 21, Spanish 8, Creole 6, Malay 5, English 4, and Fang 2. The proportional values for Christian participants are Portuguese 28.80%, French 25.55%, Turkish 23.33%, Spanish 8.88%, Creole 6.66%, English 4.44% and Fang 2.22%. The numerical values for Muslim participants are Arabic 141, Somali 78, French 72, English 46, Turkish 30, Malay 5, Tigrinia 2, and Moru 1. The proportional values for Muslim participants are Arabic 37.60%, Somali 20.80%, French 19.20%, English 12.26%, Turkish 8%, Malay 1.33%, Tigrinia 0.53%, and Moru 0.28%.

When examining language preferences for daily life based on participants' religious beliefs, Portuguese stands out as the most dominant language among Christian participants (28.80%), followed by French (25.55%) and Turkish (23.33%) as other significant preferences. Spanish (8.88%), Creole (6.66%), and English (4.44%) were preferred to a lesser extent. Among Muslim participants, Arabic (37.60%) is the most widely preferred language, followed by Somali (20.80%) and French (19.20%). English (12.26%) and Turkish (8%) were preferred to a limited extent among Muslims. While Portuguese, Spanish, and Creole play a significant role among Christian participants, languages with a strong religious context such as Arabic and Somali are prominent among Muslim participants. The noticeable preference for Turkish in both groups (23.33% and 8%, respectively) is believed to highlight Türkiye's influence in sociocultural contexts. Based on the data, it can be understood that religious beliefs significantly shape language preferences in daily life, and both global languages and local/regional languages play an important role in this context. The preference for Turkish among Christian and Muslim participants can be considered a noteworthy finding.

Table 9. Language Preferences of Participants in Daily Life-related Words Based on Religious Beliefs

	Arabic	Bambara	Fang	French	English	Spanish	Creole	Malay	Moru	Portuguese	Somali	Tigrinia	Turkish	Yoruba
Christian	0	0	0	14	1	5	5	0	0	17	0	0	48	0
Muslim	205	0	0	58	51	0	0	1	0	0	47	1	12	0

As seen in Table 9, the numerical values of the participants' language preferences for religious life-related words based on participants' religious beliefs are given. The numerical values for Christian participants are Turkish 48, Portuguese 17, French 14, Spanish 5, Creole 5, and English 1. The proportional values for Christian participants are calculated as Turkish 53.33%, Portuguese 18.18%, French 15.15%, Spanish 5.55%, Creole 5.55%, and English 1.11%. The numerical values for Muslim participants are Arabic 205, French 58, English 51, Somali 47, Turkish 12, Malay and Tigrinia 1. The proportional values for Muslim participants are Arabic 54.66%, French 15.46%, English 13.60%, Somali 12.53%, Turkish 3.20%, Malay and Tigrinia 0.26%.

When examining language preferences for religious life based on participants' religious beliefs, Turkish (53.33%) stands out as the most dominant language among Christian participants, followed by Portuguese (18.18%) and French (15.15%) as other common preferences. Spanish and Creole (5.55%) and English (1.11%) were preferred to a lesser extent. Among Muslim participants, Arabic (54.66%) is the most widely preferred language, followed by French (15.46%), English (13.60%), and Somali (12.53%). Turkish (3.20%) is used to a limited extent among Muslims. These results indicate that religious beliefs influence language preferences in religious life. The prominence of Turkish among Christian participants is noteworthy, and this may be due to Christian participants learning concepts related to Islam primarily in Turkish. The role of Arabic in the religious context among Muslim participants is evident. French stands out as a common language of preference for both groups. These findings highlight that religious and cultural contexts, as well as regional influences, play a strong role in language preferences.

CONCLUSION AND RECOMMENDATIONS

In this study, the language preferences of the participants in their sociocultural, daily and religious lives were analyzed according to their country, gender, religious beliefs and mother tongue. When the findings are considered as a whole, it is thought that the language preferences of the participants are strongly affected by historical, cultural and sociopolitical contexts. In sociocultural terms, it was seen that French stands out as the dominant language in the former French colonies, while English holds a prominent position as the language of international communication. This supports Kamwangamalu's (2000) view that French and English, as former colonial languages, still play dominant roles in the region, and in the post-colonial period, these languages are considered official and prestigious. It also aligns with Mwaniki's (2011) assertion that French and English have a significant impact on education, trade, and international communication. It is believed that the views of Wei (2000), Bhatia and Ritchie (2013), and Grosjean (2010), which suggest that the language use of bilingual/multilingual individuals is influenced by social identity, belonging, and various dynamics in social life, support this study.

Mengü (2020), states that the declining use of a language within a community is a significant factor in its risk of extinction, and the loss of its functional use in various contexts of life accelerates this dangerous process. Mengü further mentions that the preference for another language over a local language in public spaces, education, healthcare, and other institutional contexts, or the use of the language for only limited functions, are other factors contributing to the language's vulnerability. In this context, the findings of the study indicate that despite the role of local languages as carriers of cultural identity, their proportions in language preferences are generally low. This situation suggests that local languages are in danger. Therefore, it can be said that local languages should be supported, and it would be beneficial for them to be actively used in all areas of life.

When examining the language preferences of participants based on their countries in terms of sociocultural, daily, and religious life, it is clear that these preferences differ according to historical, cultural, and religious contexts. In the sociocultural context, French stands out as the dominant language in former French colonies (Mali, Gabon, Chad), while English is preferred as an international communication language in countries like Nigeria and Cameroon. Local languages, while serving as carriers of cultural identity, remain low in language preferences. The dominance of global languages in participants' daily life language preferences is notable. In this context, it is possible to say that French and English are heavily used in education, work, and social communication, while local languages (such as Somali, Tigrinya, and Fang) play a more limited role. Furthermore, Portuguese holds significant importance in daily communication in Guinea-Bissau. In the religious context, Arabic is more widely preferred in countries like Chad, Morocco, and Tunisia. This preference reflects the influence of Islam and the importance of language in religious practices. The use of Turkish in religious contexts in countries like Guinea-Bissau, Gabon, and Somalia indicates the growing cultural and religious influence of Türkiye. In conclusion, global languages dominate in sociocultural and daily life, while local elements and regional influences guide language preferences in religious contexts. Based on the findings, it is thought that preserving local languages and supporting linguistic diversity is of critical importance for cultural and linguistic sustainability.

When the language preferences of the participants regarding sociocultural, daily, and religious life were examined according to their genders within the scope of the study, significant differences were observed between the genders, and it was also revealed that global languages were dominant for both groups. Regarding sociocultural life-related words, English was more frequently preferred among female participants, while French was dominant among male participants. The higher preference for Turkish among women compared to men suggests that this language may have a more pronounced social impact on women. The limited preference of local languages in both groups is striking in terms of highlighting the dominance of global languages in the sociocultural sense. In daily life, women displayed more diverse language preferences, while men showed a stronger inclination toward Arabic and French. The fact that Somali is the most preferred language among women indicates that this language has an important place in women's daily lives. The fact that Turkish was preferred at similar rates among both groups indicates that Turkish has a significant effect on language preferences in daily life. In the religious context, Arabic stood out as the most preferred language among female and male participants. The higher preference for English and Somali in religious life among women reflects diversity in language use in this domain. The similar preference rates for Turkish between genders suggest that Turkish might hold a meaningful role as a language of choice in religious practices.

When the participants' language preferences are examined according to their religions, while French, English, and Turkish are prominent in sociocultural and daily life language preferences among Christian participants, Creole and Spanish also play a certain role. Among the Muslim participants, French, Arabic, and English were identified as their most preferred languages. As it is seen in the findings, Turkish is a significant choice for both groups, particularly with a strong influence in sociocultural contexts among Christian participants. Arabic is the dominant language among Muslim participants in terms of language preferences in religious life, while the widespread preference for Turkish among Christian participants stood out. This situation can be explained by the fact that Christian participants learn Islamic concepts in Turkish. Furthermore, French stands out as a common preferred language for both groups. In general, it has been observed that religious beliefs shape language preferences and that local and regional languages, as well as global languages, play a role in preferences. The prominent position of Turkish in both religious groups highlights the growing cultural and religious influence of Türkiye. These findings underline the importance of developing language policies that take religious and cultural contexts into account.

In line with the findings of this study, it is evident that the language preferences of African bilingual/multilingual university students are strongly shaped by historical, cultural, religious, and sociopolitical contexts. The dominance of former colonial languages such as French, English, and Portuguese in sociocultural and everyday life, alongside the limited use of local languages, reveals the weakening functional presence of these indigenous languages in public and institutional spheres. This situation highlights the necessity of supporting local languages in functional domains, as they serve as carriers of cultural identity. Increasing the visibility of local languages in education, media, and religious practices is of critical importance for ensuring the sustainability of linguistic diversity. Moreover, the noticeable differences in language preferences based on religious beliefs underscore the need for language policies to be restructured with cultural and faith-based sensitivities in mind. Another noteworthy finding of the study is that Turkish has emerged as a preferred language in both religious and sociocultural contexts among both Muslim and Christian participants. This can be interpreted as a reflection of Türkiye's cultural influence on international students, demonstrating that Turkish functions not only as a means of communication for multilingual individuals but also as a tool for establishing sociocultural connections. Therefore, it is suggested that Turkish language education programs be diversified on the basis of cultural sensitivity to foster students' sense of social belonging. Furthermore, the broader linguistic repertoire observed among female participants indicates that gender-based linguistic experiences and social roles are reflected in language preferences, thereby emphasizing the necessity of developing pedagogical approaches in language education that incorporate gender sensitivity. Considering the limited sample of this study, conducting further research with larger and more diverse demographic groups will yield deeper and more generalizable insights into the linguistic practices of African students.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

An ethics committee report was received from the Scientific Research and Publication Ethics Committee of Kastamonu University, dated 06/11/2024, numbered 35/11.

REFERENCES

- Akinci, M-A. (2016). Culture d'origine et apprentissage : le cas des jeunes enfants bilingues issus de familles immigrées originaires de Turquie. Auzou-Caillemet, T. & Loret, M. (éds.), *Prendre en compte le corps et l'origine socioculturelle dans les apprentissages*. Paris: Retz, collection « Co-édition », 202-238.
- Bamgbose, A. (1991). *Language and the nation. The Language question in Sub-Sahara Africa*. England: Englewood University Press.
- Bhatia, Tej & William C. Ritchie (eds). (2013). Second edition. *The handbook of bilingualism and multilingualism*. Malden, MA & Oxford, UK: Wiley-Blackwell.
- Blommaert, J. (2010). *The sociolinguistics of globalization*. Cambridge: Cambridge University Press.
- Bloomfield, L. (1933). *Language*. New York: Holt, Rinehart and Winston
- Cummins, J. (1981). Four misconceptions about language proficiency in bilingual education. *Nabe Journal*, 5(3), 31-45.
- Deshays, E. (1990). *L'enfant bilingue*. Paris: Robert Laffont.
- Ervin, S. M. & Osgood, C.E. (1954). Second language learning and bilingualism. *Journal of Abn and Soc Psy*, 58, 139-145.
- Fishman, J. A. (1965). Bilingualism intelligence and language learning. *Modern Language Journal*, 49, 227-237.
- Grosjean, F. (2010). *Bilingual: Life and reality*. Harvard University Press. <https://doi.org/10.4159/9780674056459>
- Hamers, J. F. & Blanc, M. H. A. (2000). *Bilingualism and bilingualism*. Cambridge: Cambridge University Press.
- Haugen, E. (1953). *The norwegian langauge in America: A sudy in bilingual behavior*. Philadelphia: Penn., University of Pennsylvania Press.
- İmamaliyeva, Ü. (2023). Kültürel çeşitlilikte Afrika kültürü. *Balkan & Near Eastern Journal of Social Sciences (BNEJSS)*, 9(4), 37-42.
- Kamwangamalu, N. M. (2000). A new language policy, old language practices: status planning for African languages in a multilingual South Africa. *South African Journal of African Languages*, 20(1), 50–60. <https://doi.org/10.1080/02572117.2000.10587412>
- Karaca, S. O. (2024). Dilin milliyetçilik üzerindeki etkisi bağlamında Fransa'nın Afrika sömürgelerindeki milliyetçiliği önleme politikaları. *Uluslararası Politik Araştırmalar Dergisi*, 10(1), 17-30. <https://doi.org/10.25272/icps.1448140>
- Karasar, N. (2014). *Bilimsel araştırma yöntemi*. (26.baskı). Ankara Nobel Yayınevi.
- Kavak, G. (2021). İngiliz koloni yönetiminin Nijerya'daki hâkimiyet araçları ve günümüzdeki yansımaları. *Africana*, 1(1), 121-144.
- Loeb, S., Dynarski, S., McFarland, D., Morris, P., Reardon, S., & Reber, S. (2017). Descriptive Analysis in Education: A Guide for Researchers. NCEE 2017-4023. *National Center for Education Evaluation and Regional Assistance*.
- Macnamara, J. (1967). The linguistic independence of bilinguals. *Journal of Verbal Learning & Verbal Behavior*, 6(5), 729–736. [https://doi.org/10.1016/S0022-5371\(67\)80078-1](https://doi.org/10.1016/S0022-5371(67)80078-1)
- Mazrui, A.A. & Mazrui, A.M. (1998). *The power of Babel: Language and governance in the African experience*. London: James Currey Ltd.
- Mengü, G. (2020). Afrika'da tehlike altında olan dilleri koruma ve yaşatmaya yönelik mobil uygulama önerileri, *AHBV Akdeniz Havzası ve Afrika Medeniyetleri Dergisi*, 2(2), 112-121.
- Mohanty, A. K. (1994). *Bilingualism in a multilingual society psycho-social and pedagogical implications*. Mysore: Central Institute of Indian Languages.
- Mufwene, S. S. (2001). *The ecology of language evolution*. Cambridge: Cambridge University Press.
- Mwaniki, M. (2011). Language management in Africa: The dialectics of theory and practice. *Southern African Linguistics and Applied Language Studies*, 29(3), 243–257. <https://doi.org/10.2989/16073614.2011.647487>
- Norton, B (2013). Identity, literacy and the multilingual classroom. In S. May (Ed.) *The multilingual turn: Implications for SLA, TESOL and bilingual education* (pp. 103-122). New York: Routledge.
- Omoniyi, T. & Fishman, J. A. (Eds.). (2006). *Explorations in the sociology of language and religion*. John Benjamins Publishing Company. <https://doi.org/10.1075/dapsac.20>
- Pavlenko, A. & Blackledge, A. (2004). Introduction: New theoretical approaches to the study of negotiation of identities in multilingual contexts. In A. Pavlenko & A. Blackledge (Ed.), *Negotiation of Identities in Multilingual Contexts* (pp. 1-33). Bristol, Blue Ridge Summit: Multilingual Matters. <https://doi.org/10.21832/9781853596483-003>

- Spolsky, B. (2003). 5. Religion as a site of language contact. *Annual Review of Applied Linguistics*, 23, 81–94. Doi:10.1017/S0267190503000205
- Süverdem, F. B. & Ertek, B. (2020). İki dillilik ve iki kültürlülük: göç, kimlik ve aidiyet. *The Journal of International Lingual Social and Educational Sciences*, 6(2), 183-207.
- Tosi, A. (1982). Mother tongue teaching for the children of migrants. Kinsella, V. (ed.), *Surveys 1, Cambridge Language Teaching Surveys*. Cambridge University Press.
- Wei, L. (Ed.). (2000). *The bilingualism reader* (Vol. 11). London: Routledge.
- Weinreich, U. (1953). *Languages in contact*. The Hague: Mouton de Gruyter.
- Yiğit, M. & Soumana, Y. (2019). Arap dilinin Batı Afrika kültürüne etkisi. *KSÜ İlahiyat Fakültesi Dergisi*. 34, 253-288. <https://doi.org/10.35209/ksuifd.631697>.



Research Article / Araştırma Makalesi

The Impact of Artificial Intelligence on University Teaching Processes: An Analysis Based on Faculty Perspectives*

Yapay Zekânın Üniversitedeki Öğretim Süreçlerine Etkileri: Öğretim Elemanı Görüşlerine Dayalı Bir İnceleme

Serap Samsa Yetik¹

Keywords

Artificial intelligence
Higher education
Teaching processes
Teaching staff
Teaching competence

Anahtar Kelimeler

Yapay zekâ
Yükseköğretim
Öğretim süreçleri
Öğretim elemanları
Öğretim yetkinliği

Received/Başvuru Tarihi
19.12.2024

Accepted / Kabul Tarihi
25.07.2025

Abstract

Artificial Intelligence (AI) technologies are developing, diversifying and increasing their impact on learning-teaching environments. Higher education, with its various disciplines and their instructional applications, is also significantly influenced by these developments. However, despite all this development, lecturers' tendency to use AI for educational purposes is transforming depending on their thoughts and intentions on this issue. From this point of view, this study examines the views of lecturers on the possible effects of AI technologies on their teaching-learning processes. The participants were selected voluntarily from among the lecturers working at universities in Turkey with different positions and titles, taking into account the balance of experience, title and gender. The data collection package included an 8-question semi-structured data collection form developed by the researcher. The collected data were analyzed using inductive content analysis, enabling the identification of themes based on common concepts. The themes were evaluated in terms of the opportunities offered by AI in the field of higher education today with their strengths and aspects open to improvement. The findings revealed that faculty members use AI technologies especially in language models, visual content creation tools and automated assessment systems; these technologies offer advantages such as time saving, individualized learning opportunities and content enrichment. However, challenges such as ethical issues and academic integrity risks were also identified. The research provides insights into the future role of AI technologies in higher education and lays the groundwork for recommendations for educational policies.

Öz

Yapay zekâ teknolojileri gün geçtikçe gelişmekte, çeşitlenmekte ve öğrenme-öğretme ortamları üzerindeki etkilerini artırmaktadır. Yükseköğretim düzeyi de gerek farklı bilim alanları gerekse bunların öğretimine ilişkin yansımaları ile bu etkiden payını almaktadır. Bununla birlikte tüm bu gelişime karşın, öğretim elemanlarının yapay zekâyı eğitsel amaçlarla kullanım eğilimleri başat biçimde bu konudaki düşünce ve niyetlerine bağlı biçimde dönüşmektedir. Araştırmada bu bakıştan hareketle öğretim elemanlarının yapay zekâ teknolojilerinin kendi öğretme-öğrenme süreçleri üzerine olası etkilerine ilişkin görüşleri incelenmektedir. Katılımcılar Türkiye'deki üniversitelerde farklı kadro ve unvanlarla görev yapmakta olan öğretim elemanları arasından gönüllülük usulü ile ve deneyim, unvan ve cinsiyet dengesi gözetilerek belirlenmiştir. Veri toplama paketinde araştırmacı tarafından geliştirilen 8 soruluk yarı yapılandırılmış bir veri toplama formu yer almaktadır. Elde edilen veriler tümevarımcı içerik analizleri ile çözümlenmiş, böylece ortak kavramlar üzerinden temalara erişilmiştir. Erişilen temalar yapay zekânın günümüzde yükseköğretim alanında sunduğu fırsatlar ekseninde güçlü ve geliştirmeye açık yönleri ile değerlendirilmiştir. Bulgular, öğretim üyelerinin yapay zekâ teknolojilerini özellikle dil modelleri, görsel içerik oluşturma araçları ve otomatik değerlendirme sistemlerinde kullandıklarını; bu teknolojilerin zaman tasarrufu, bireyselleştirilmiş öğrenme fırsatları ve içerik zenginleştirme gibi avantajlar sunduğunu ortaya koymuştur. Ancak, etik sorunlar, akademik dürüstlük riskleri gibi zorluklar da tespit edilmiştir. Araştırma, yapay zekâ teknolojilerinin yükseköğretimde gelecekteki rolüne ilişkin öngörüler sunmakta ve eğitim politikalarına yönelik önerilere zemin hazırlamaktadır.

* This study was presented at the 17th International Computer and Instructional Technologies Symposium held on 3-5 October 2024 in Kastamonu.

¹ Pamukkale University, Faculty of Education, Department of Computer Education and Instructional Technologies, Denizli, Türkiye; ssamsa@pau.edu.tr; <https://orcid.org/0000-0002-2419-8010>

INTRODUCTION

As one of the most dynamic and rapidly developing fields of computer science, Artificial Intelligence (AI) is at the center of today's digital transformation. As a set of algorithms and systems that mimic human intelligence, it not only drives technological developments, but also creates a transformational impact in many fields such as education, health, economy and social interaction. This transformation manifests itself in a wide range of areas, from the daily lives of individuals to corporate decision-making processes, and brings new opportunities as well as ethical, legal and social challenges. Understanding and managing these multidimensional impacts of AI has become a priority agenda item for both decision makers and academics.

AI is not only a technological innovation, but a paradigm shift that is at the center of scientific research, educational processes and social transformations. AI, which has its theoretical foundations in Aristotle's formal logic and syllogistic theory (Oliveira & Figueiredo, 2023; McCorduck, 2004), was shaped by Charles Babbage's analytical machine and Ada Lovelace's programmable computation (Oliveira & Figueiredo, 2023) in the 19th century, and gained its modern framework with the work of Alan Turing in the 20th century (Turing, 1936).

Today, technologies such as big data analytics, deep learning and natural language processing have expanded the uses of AI in education (Yim, 2024; Joo & Park, 2024). Especially in higher education, AI is reshaping teaching, learning and assessment processes, as well as optimizing administrative processes and redefining ethical responsibilities (Chiu et al., 2023; Stahl et al., 2022). Personalized learning platforms and big language models provide students with content tailored to their individual needs, while providing faculty with rapid assessment tools (Chiu et al., 2023; Jin et al., 2024; Galindo-Domínguez et al., 2024).

Several studies focusing on the potential applications and impacts of AI in higher education elaborate on the opportunities and challenges of this technology in educational processes (e.g. Al Ka'bi, 2023; Chiu et al., 2023; Laupichler et al., 2022; McGrath et al., 2023). The studies address various aspects of AI in higher education, such as personalizing learning processes, student assessment, faculty attitudes, and ethical dimensions of the technology. They also focus on AI literacy and strategies for the fair and effective use of technology in education.

Theoretical Framework

McCarthy's definition of AI, made in 1956 during the Dartmouth Summer Research Project, is based on the assumption that certain features of human cognitive processes, such as intelligence and learning, can in principle be precisely defined and imitated by machines. This definition presupposes that the basic principles of how human intelligence works can be clearly articulated and modeled in a mathematical or logical framework. With this approach, McCarthy emphasized the potential of machines to perform human-like thinking and problem-solving processes. This expresses an important assumption that drives the study of AI and is based on the idea that the basic principles of human intelligence are understandable and can be applied by a machine (McCarthy et al., 2006). While McCarthy emphasizes that machines can improve their learning and problem-solving abilities by imitating human intelligence, Newell and Simon (1956) put this vision into a concrete framework with their project "The Logic Theory Machine". Both definitions point to the application of human-like thinking and problem-solving abilities in digital systems as the main goal of AI.

These premise approaches on the definition and goals of AI have been addressed in a broader context with the development of technology in the historical process. In particular, Alan Turing's work questioning the thinking capacity of computers (Turing, 1950) and the vision put forward at the 1956 Dartmouth Conference formed the basic theoretical infrastructure of AI. This historical process reveals the development of AI research from early theories based on the idea that machines can function in a similar way to human thinking to contemporary applications such as machine learning and big data (Oliveira & Figueiredo, 2023). When we look at the historical development of AI, we see that its foundations extend from philosophical thoughts to today's technologies. Humanity's efforts to understand the concepts of thinking and consciousness constitute the origins of AI (McCorduck, 2004; Nilsson, 2009). Aristotle's work on syllogism and formalization of logic laid the groundwork for the logical foundations of modern AI as an important factor affecting the theoretical foundations of AI (McCorduck, 2004; Oliveira & Figueiredo, 2023; Burmeister, 2023). Descartes invented a coordinate system that allowed to transform geometry problems into algebra problems and to write functions (Sargent, In Press). Leibniz and Pascal laid the foundation of mathematical logic by working on the formalization of computation and logic (Nilsson, 2009; McCorduck, 2004; Oliveira & Figueiredo, 2023). In the early 20th century, developments in mathematics and logic laid the foundation for modern computers and AI (Nilsson, 2009). Turing's concept of the "Turing Machine" (1936) defined the theoretical limits of computation and laid the foundation for digital computers (Turing, 1936). McCulloch and Pitts (1943) laid the foundation of artificial neural networks by presenting a mathematical model of neural cells. Turing (1950) proposed the Turing Test by questioning the capacity of a machine to think and used it to evaluate whether the machine exhibited human-like intelligence. In 1956, the term "Artificial Intelligence" was used for the first time at a conference at Dartmouth College, and this event was considered the official birth of AI (McCarthy et al., 2006). In the 1950s and 1960s, researchers focused on symbolic AI and rule-based systems (Nilsson, 2009; McCarthy et al., 2006; Russell & Norvig, 2021). "The Logic Theory Machine" developed by Newell and Simon (1956) was a pioneering step in the field of AI as one of the first software used to prove mathematical theorems. "General Problem Solver" (1961), which they developed later, is a system that mimics the general problem solving processes of humans and can solve various problems. Samuel (1959) provided an early example of machine learning with a checkers program that could improve its performance by learning from gaming experiences.

(Russell & Norvig, 2021; Grzybowski et al., 2024). In the 1960s, the increasing capacity of computers enabled significant advances in AI (Nilsson, 2009). A General Problem Solver is a system that models problems between initial and target states and aims to identify optimal solutions using heuristics. Thanks to its ability to mimic human reasoning processes, the General Problem Solver was recognized as an important milestone in the fields of AI and cognitive science (Newell & Simon, 1961). In the same period, ELIZA, developed by Weizenbaum, pioneered human-machine interaction as one of the first chatbots in natural language processing. Using pattern matching methods, this system laid the foundation for modern chatbots, but Weizenbaum pointed out the ethical risks of such technologies. GPS and ELIZA are recognized as the cornerstones of AI in problem solving and natural language processing (Weizenbaum, 1966).

The optimism of their early successes was tempered by the difficulties encountered in practical applications. It has been observed that machines struggle to understand real-world complexity and symbolic approaches are limited (Russell & Norvig, 2021). These criticisms reduced the interest in neural networks and caused research to focus on symbolic methods (Nilsson, 2009; Russell & Norvig, 2021). In the 1970s and 1980s, AI research experienced a period of stagnation, dubbed the “Winter of AI”. Lack of funding and waning interest led to many projects being halted or slowed down. This period revealed the limits of AI’s capacity to deal with real-world problems, and it became clear that symbolic methods were insufficient to solve complex problems (Nilsson, 2009; WIPO, 2024; Muthukrishnan et al., 2020). During this period, symbolic methods and expert systems gained popularity. MYCIN attracted attention as an expert system designed for medical diagnosis, while DENDRAL achieved success in chemical analysis processes (Buchanan & Feigenbaum, 1978; Enslin & Kaul, In Press). Japan’s Fifth Generation Computer Project gave a new impetus to AI research, but did not fully meet expectations (Nilsson, 2009). While these projects have demonstrated the applicability of AI in specific fields, achieving overall AI goals is still a distant goal (WIPO, 2024). In the 1990s, statistical methods and data mining techniques came to the fore. Machine learning focused on the development of algorithms that learn from experience and build models based on data (Fayyad et al., 1996; Mitchell, 1999). In 1997, IBM’s Deep Blue computer achieved a significant success by defeating world champion Garry Kasparov in chess (Campbell et al., 2002). In the 2000s, the explosion of the internet and digital data gave rise to the concept of “big data” (Manyika et al., 2011). This wealth of data has enabled machine learning and AI models to be trained more effectively (Russell & Norvig, 2021) and has enabled the use of multilayer artificial neural networks in deep learning to learn complex data relationships (LeCun et al., 2015). For example, AlexNet, developed by Krizhevsky et al. (2012), achieved great success in the ImageNet Image Recognition Competition. The 2010s was a period when AI technologies were applied in a wide variety of fields and became an integral part of social and economic life (Russell & Norvig, 2021). Advances in deep learning and artificial neural networks enabled AI to surpass human performance in complex tasks. In 2016, Google DeepMind’s AlphaGo program achieved an important milestone by defeating world champion Lee Sedol in the game of Go (Silver et al., 2016).

Today, AI technologies offer a more innovative, personalized and efficient learning environment by reshaping teaching and learning processes in the education sector. Adaptive instructional systems analyze students’ individual needs, provide customized content, and optimize learning processes. In addition to these systems, smart teaching tools provide guidance and instant feedback to students, enhancing their learning experience (Ma et al., 2014). Virtual assistants and chatbots offer academic guidance and support by providing continuous access to students. These tools have the potential to provide instant access to learning materials, answer questions quickly and facilitate learning processes (Okonkwo & Ade-Ibijola, 2021; Chiu et al., 2023). Automated assessment systems reduce the workload of instructors by enabling quick and objective evaluation of exams and assignments (Burrows et al., 2015). These developments show that AI applications positively affect student satisfaction and success by providing individualized learning and operational efficiency in education.

This transformation in the field of education also offers important opportunities for instructors and administrators in higher education. In particular, adaptive learning and automated assessment systems allow universities to monitor student progress more effectively, increase individual achievement, and manage academic processes more efficiently (Burrows et al., 2015; Chiu et al., 2023). In higher education, AI-powered tools use learning analytics to provide solutions tailored to student needs and develop personalized educational experiences (Galindo-Domínguez et al., 2024; Kumar et al., 2024). In addition, virtual assistants and natural language processing technologies support student advising services, facilitating academic guidance processes and increasing access (Chiu et al., 2023). These applications have significant potential to raise the quality of education and improve the student experience in universities.

However, the use of AI in higher education also raises ethical issues such as data privacy, algorithmic bias and lack of transparency. International regulations and institutional policies are recommended to address these issues (Stahl et al., 2022; Oliveira & Figueiredo, 2023). Moreover, increasing the digital competencies of faculty members is critical for the effective adoption of AI technologies (Galindo-Domínguez et al., 2024; Burmeister, 2023). This technological transformation in education draws attention to the potential of AI applications to positively affect student satisfaction and achievement by providing individualized learning and operational efficiency in education. In this context, the aim of this study is to determine the level of use of AI technologies, their integration into teaching processes, and their perceptions and thoughts about these technologies. In this context, the following questions are addressed;

1. What is the frequency of faculty members’ use of AI technologies?
2. For what purposes do faculty members use AI technologies?
3. What are the perceptions and attitudes of faculty members towards AI technologies?

4. What is the effect of AI technologies on teaching methods?
5. What is the impact of AI technologies on assessment and evaluation processes (exams, homework and other assessment tools)?
6. What are the opportunities and challenges of AI technologies in the context of higher education?
7. How do faculty members envision the potential future impact of AI technologies?

METHOD

The research was conducted within the framework of a qualitative research design. Qualitative research design is an essentially interpretive approach that focuses on the interaction of events-people-sociocultural environment, which is preferred in terms of understanding the phenomenon/situation in depth with its sociocultural dimensions. In this direction, it covers the experience and interaction with the dimension of what is felt beyond what is seen and heard (Liamputtong, 2019). With this perspective, care was taken to preserve the authenticity and richness of the participant experience as much as possible. During the data collection process, participant opinions were collected as openly as possible and within their own contexts, and the richness and depth of the data accessed were preserved as much as possible in the analysis process.

Participants

The participants were selected on a voluntary basis from among the academic staff working in different positions and titles in universities in Turkey. In this context, it can be stated that a convenience sampling approach was employed. However, in the selection of participants, diversity was tried to be ensured by considering the balance of experience, title and gender, thus trying to reach a certain richness in terms of perspective and experience accumulation.

When the demographic characteristics of the participant group are analyzed, it is seen that 50% of them are female (16 participants) and 50% are male (16 participants). Their seniority rang between 8 and 30 years ($M=20.44$, $SD=5.53$). According to their titles, 46.88% (15 participants) are Associate Professor, 25% (8 participants) are Assistant Professor, 12.5% (4 participants) are Dr., Instructor, 9.38% (3 participants) are Instructor, and 6.25% (2 participants) are Professor. Table 1 presents this information in detail.

Table 1. Demographic information of the participants

Participant (P)	Gender	Seniority Year	Title	Participant (P)	Gender	Seniority Year	Title
P ₁	Male	26	Instructor	P ₁₇	Male	30	Dr., Instructor
P ₂	Male	14	Assist. Prof.	P ₁₈	Woman	19	Assoc. Prof.
P ₃	Male	30	Assist. Prof.	P ₁₉	Male	30	Assoc. Prof.
P ₄	Male	22	Instructor	P ₂₀	Male	28	Assoc. Prof.
P ₅	Woman	25	Prof.	P ₂₁	Woman	23	Assist. Prof.
P ₆	Woman	9	Assist. Prof.	P ₂₂	Woman	15	Assist. Prof.
P ₇	Male	8	Assist. Prof.	P ₂₃	Male	25	Assoc. Prof.
P ₈	Woman	20	Assoc. Prof.	P ₂₄	Woman	18	Dr., Instructor
P ₉	Male	24	Assoc. Prof.	P ₂₅	Woman	21	Assoc. Prof.
P ₁₀	Woman	17	Assoc. Prof.	P ₂₆	Woman	23	Assoc. Prof.
P ₁₁	Male	10	Assoc. Prof.	P ₂₇	Male	22	Assoc. Prof.
P ₁₂	Woman	19	Assoc. Prof.	P ₂₈	Woman	19	Assoc. Prof.
P ₁₃	Woman	19	Assist. Prof.	P ₂₉	Woman	22	Instructor
P ₁₄	Woman	20	Dr., Instructor	P ₃₀	Male	18	Assoc. Prof.
P ₁₅	Male	20	Assoc. Prof.	P ₃₁	Woman	17	Assist. Prof.
P ₁₆	Male	21	Prof.	P ₃₂	Male	20	Dr., Instructor

The group is equal in terms of gender distribution. The average seniority of the group is above 20 years, indicating a saturation in terms of professional experience. The diversity in the distribution of titles similarly contributes to the richness of experience.

Instrument and Data Collection

The research data were collected through an 8-question semi-structured interview form developed by the researcher based on expert opinions. During the development process of the form, draft items were written by the researcher. Then, using the Delphi technique, the draft form was presented to two independent experts with doctoral degrees in educational technology and similar research experience, and the process of consultation and refinement continued until the researcher and the experts agreed

on all questions. The finalized questionnaire provided participants with a general framework for expressing their thoughts on the topic, while at the same time allowing them flexibility to freely express their different opinions. This approach not only allows participants to share their experiences and perspectives in detail, but also contributes to systematic and comparable data collection.

The data collection period covered the fall semester of the 2024-2025 academic year. Interviews were conducted face-to-face or online in line with the participants' communication preferences and geographical distances. The researcher conducted all interviews herself. In this context, the interviews were meticulously planned in terms of time utilization and the use of prompts. Throughout the interview process, the researcher adopted a strategy that encouraged the participant to convey as many feelings, thoughts and experiences as possible without directing them about the subject.

Data Analysis

The data were analyzed by inductive content analysis. Thus, an inclusive and in-depth structure was tried to be reached for all data without any presuppositions or assumptions. Qualitative researchers do not state hypotheses clearly and precisely. Before deciding what the important questions to be considered are, data are collected as a result of long-term studies, and then these data are synthesized by induction to make generalizations (Büyükoztürk et al., 2013). Preliminary examinations and groupings were made by the researcher on the data obtained per this process. Then, themes were accessed by deeper reading and examinations within each group. Regroupings were made based on the relationships between the themes and thus the main themes were reached. The analysis studies were carried out by the researcher. In this process, the researcher met three times with an external expert in the field of educational technology and consulted his/her opinions on the coding process and the themes accessed. Throughout the entire research process, ethical principles were meticulously taken into consideration and the confidentiality and privacy of the participants were protected. In this context, data were anonymized and used in both the analysis and reporting process. With all these measures, the validity and reliability of the research process, as well as the objectivity of the researcher, were continuously maintained.

Limitations

An important limitation of the research is the low number of participants. One justification at this point is, of course, that qualitative research is concerned with reaching in-depth results rather than generalizability. However, this situation should be taken into consideration in the evaluation of the results obtained from the research. A second limitation is that the research focuses on the personal thoughts of the lecturers beyond the factors such as the technology access opportunities of their institutions and their views on this issue. Of course, factors such as the technology availability of the work environment, perspectives and norms regarding the use of artificial intelligence are also effective in a faculty member's professional relationship with artificial intelligence technology. However, such institutional characteristics were excluded from the scope of the study, as the increase in the number of questions may reduce the depth of the answers. A third limitation is the use of the framework developed by the researcher as the main analysis framework. At this point, it was thought that the analysis framework, whose content validity had already been studied, would contribute to the validity of the results. However, while forming themes within this framework, it was tried to preserve the richness of thought and experience by remaining as deductive as possible.

FINDINGS

In this section, the findings are presented under four main themes: "Use and Experience Level of Artificial Intelligence Technologies", "Effects of Artificial Intelligence on Teaching Methods and Materials", "Effects of Artificial Intelligence on Student Learning and Development Processes" and "Effects of Artificial Intelligence on Assessment and Evaluation Processes".

Use of Artificial Intelligence Technologies and Level of Experience

The codes collected under this theme reveal three sub-dimensions: "Experience with Artificial Intelligence Technologies", "Purposes of Use" and "Experience Levels".

Experience with Artificial Intelligence Technologies

When the data are analyzed, it is seen that the most frequently used artificial intelligence technologies of the participants are divided into five different categories according to their areas of use.

Language Models and Chat Bots: A significant group of participants use ChatGPT for different purposes. This use is supported by similar technologies such as Google Gemini and Google Bard. In addition, one participant used the more general term Google AI Chatbot (artificial intelligence tools of Google) to refer to an all-encompassing approach to Google's family of chatbots. Sample participant statements are given below;

P₁: "Yes: ChatGPT, Google AI Chatbot"

P₂: "ChatGPT, Google Gemini and Google Bard, Gamma"

P₂₁: "I used ChatGPT for my research and to expand the course content."

Visual and Presentation Tools: Participants stated that they frequently used tools such as Canva (including the artificial intelligence model DALL-E), Suno, Midjourney and Gamma to prepare visual content and presentations. However, one participant considered Quiver, a visual content production tool, as one of the artificial intelligence tools. Similarly, another participant evaluated the Story Jumper tool within the scope of artificial intelligence technologies. Sample participant statements are given below;

P₆ : “ChatGPT, Suno, Midjourney”

P₁₈ : “For educational purposes, I use artificial intelligence tools such as Gamma for creating presentations, ChatGPT for activity lesson plans, Eduaide for evaluation, lesson plans, activities, game activities, and DALL-E in Canva for visuals.”

P₂₈ : “I used ChatGBT, Quiver, Story Jumper.”

Writing Code and Software Development Tools: In the light of the analysis, it was observed that the participants worked on concepts using techniques such as NLP and machine learning. In addition, some participants stated that they experienced Copilot, Abacus AI and Google Gemini tools. Google Gemini was also evaluated in this category due to the support it provides in both software development and code writing processes. Sample participant statements are given below;

P₅ : “NLP etc. like working the concept with machine learning.”

P₉ : “Experiencing. Copilot, Google Gemini.”

P₁₀ : “Writing code, presenting ready-made information.”

P₁₂ : “ChatGPT, Abacus AI”

Language and Spelling Tools: Participants stated that they use tools such as Grammarly and Diffit for grammar and style control of written content. Sample participant statements are given below;

P₁₁ : “Yes. Chatgpt, Canva, Diffit, Gemini.”

P₁₆ : “Yes, ChatGPT, Grammerly”

P₂₇ : “ChatGPT, Grammerly, Google Gemini”

Voice Assistants and Applications Used in Daily Life: In the participant statements, it is understood that mobile phone applications (voice assistants, navigation, etc.), language translation programs, voice assistants such as Siri, Google Assistant and translation tools such as Google Lens have been experienced. Sample participant statements under this theme are as follows;

P₁₇ : “Mobile phone applications (voice assistants, navigation, etc.), language translation programs, Chatbot, ChatGPT, software programs”

P₃₁ : “I use voice assistants like Siri, Google Assistant, and Google Lens for translation.”

When the codes are analyzed, it is seen that ChatGPT is among the most widely used artificial intelligence technologies. Google Bard and Google Gemini are other widely used language models. At the same time, participants stated that they preferred tools such as Canva (DALL-E supported), Midjourney and Gamma for visual content production and presentation preparation. In software development and code writing processes, it was observed that artificial intelligence supported tools such as Copilot, Abacus AI and Google Gemini were widely used. Language and spell checking tools such as Grammarly and Diffit are also used effectively by the participants. In daily life, Siri, Google Assistant, Google Translate and various AI-supported suggestion systems were used. In addition, some participants offer a different perspective by stating that they also use tools such as SciSpace and Eduaide, which cannot be considered as artificial intelligence tools.

Purposes of Use

In the light of the data, it was determined that the participants' purposes of using artificial intelligence technologies were classified in three different categories.

Instructional Material Preparation and Content Creation: As a result of the analysis, it was seen that the contributions of artificial intelligence technologies to course material preparation and content development processes were particularly emphasized. It was stated by the instructors that ChatGPT was used effectively for purposes such as content generation, question preparation, translation, narration and question-answer. This use was followed by Google Gemini and it was observed that this tool was also used by the instructors with similar functions. It is stated that artificial intelligence tools support creativity in material production and increase the efficiency of teaching materials.

Participants indicated that tools such as Canva's DALL-E supported features, Diffit, Suno and Midjourney play an important role in producing visual content and enriching course materials. In addition, tools such as Gamma, Copilot and Eduaide are used in learning planning and assessment processes. These tools enrich both the content and presentation of instructional materials by supporting the production of content tailored to student needs. In general, participants expressed that the integration of AI technologies into teaching processes plays an important role in developing materials and improving learning experiences. Sample participant statements are presented below;

P₆ : “I used tools like Suno, Midjourney to prepare visual materials.”

P₁₁ : "While showing Canva for design in my classes, I briefly showed the artificial intelligence support in it. Apart from that, I had students do activities with ChatGPT in my classes about the basic use of artificial intelligence. I showed Diffit similarly in in-class activities. I use Gemini and ChatGPT for translations or when I want to learn any information."

P₁₈ : "I use artificial intelligence tools such as Gamma for creating presentations, ChatGPT for activities and lesson plans, Eduaide for assessment and game activities, and DALL-E in Canva for visuals."

P₂₅ : "I also use ChatGPT to expand my course content. It also helps with question preparation and assignments."

Research, Academic Work and Grammar: Participants state that artificial intelligence tools are used effectively in research, academic studies and grammar editing. It is stated that these technologies make significant contributions in areas such as expanding the scope of research, enriching course content, preparing questions and providing support in homework processes. In the statements of the participants, it was concluded that the ChatGPT tool is frequently used in academic studies and is used effectively in generating ideas in theoretical discussions, translating, preparing academic papers and editing texts. In addition, it is stated that Grammarly is preferred by the instructors for grammar and style editing, and that artificial intelligence provides important support in academic processes such as visual production, summarizing, data analysis and content creation. Sample participant statements are presented below;

P₈ : "I have used it in my own work, for theoretical and argumentative ideas in articles."

P₂₅ : "I used ChatGPT. I used it to expand my research."

P₃₀ : "I used it for editing in my academic studies."

Student Support and Guidance: Participants state that artificial intelligence tools are used effectively in student support and guidance processes; they offer benefits such as responding quickly to students' questions, providing content suitable for individual learning speed and style, and providing support in target behavior and planning processes. It is emphasized that tools such as Google Translate and Grammarly improve students' written content by providing guidance in grammar and style editing, thus contributing to teachers. Artificial intelligence-based systems are said to provide personalized feedback and guidance to students, analyzing their academic and emotional states and producing solutions for their individual needs; it is stated that these technologies make important contributions in providing materials suitable for individual learning needs and supporting student-centered learning environments. Examples of relevant statements are presented below;

P₁₁ : "I use Gemini and ChatGPT for my translations or when I want to know any information. I have also used these tools in my classes to provide information to students quickly."

P₁₆ : "Artificial intelligence in Psychological Counseling and Guidance education can provide a great advantage in providing personalized feedback and support to students. Students' academic and emotional states can be analyzed and more effective guidance can be provided."

P₂₂ : "It can help students to prepare sample exam questions and produce answers by uploading the content of the course. I think it supports their study skills on this subject."

Participants state that artificial intelligence technologies are used effectively in the processes of preparing teaching materials, content creation, evaluation and student guidance, adding content richness and supporting creativity. It is emphasized that tools such as ChatGPT, Canva, Diffit and Google Gemini are effective in content generation, translation, question preparation and visual material creation, while tools such as Grammarly are effective in grammar and style editing. In addition, it is stated that artificial intelligence tools make important contributions in providing individualized learning experiences by analyzing student progress, making educational processes more efficient and supporting student-centered learning environments.

Experience Levels

The analysis of the data reveals that the most frequently used areas of use of artificial intelligence technologies by the participants are grouped into three main categories.

Intensive Users: A significant number of participants stated that they use artificial intelligence technologies intensively and regularly and that these tools provide indispensable support in teaching and research processes. It is stated that tools such as ChatGPT, Copilot, Canva- DALL-E, Diffit, Grammarly, Gamma and Eduaide are used effectively especially in educational functions such as content creation, question preparation, presentation and lesson planning, game and activity development. It is emphasized that these tools are useful in tasks such as text analysis, language translation, visual production, summarizing, information gathering, automatic evaluation and learning analytics. Participants stated that artificial intelligence technologies enrich learning experiences by providing individualized content, increase efficiency in teaching processes and facilitate daily tasks. Sample statements on the subject are presented below;

P₁₈ : "For educational purposes; I use artificial intelligence tools such as gamma to create presentations, chatbot ChatGPT for activity lesson plan, Eduaide for evaluation, lesson plan, activity, game activities, DALLI-E in Canva for visuals."

P₂₀ : "Yes, ChatGPT and copilot, creating images, summarizing (books, articles, etc.), collecting information about a topic, etc."

P₃₂ : "Yes, I have experienced artificial intelligence technologies. In particular, I use the following tools: Automated assessment systems: To quickly assess student assignments and exams. Learning analytics: To monitor and analyze students' performance."

Chatbots: To provide immediate support to students. Content recommendation systems: To provide learners with resources and materials based on their interests. Art and software creation tools: I use them to develop ideas for creative projects."

Limited or Beginner Use: The statements in this dimension indicate that AI tools are partially experienced but not fully integrated into teaching processes. Although the potential benefits of AI are recognized, more information is needed for its effective use. In particular, the lecturers tried tools such as ChatGPT in their individual studies for text generation, translation, visual content preparation and supporting teaching materials. At this point, they stated that they plan to use it more in their lessons or exams in the future. In general, it is emphasized that they are open to the possibilities offered by artificial intelligence in education, but their level of use is at the beginning stage. Sample statements are presented below;

P₉ : "I usually use it to answer questions or to create a text. Recently I have been using it to support teaching materials to create visuals."

P₁₄ : "I plan to use it in my classes."

P₂₇ : "I have experienced AI technologies in a limited way for instructional purposes. I have mostly used tools like ChatGPT to guide student assignments or activities. For example, I have used it to expand course content or to better articulate homework questions. However, these uses have been at the beginner level."

Non-users: A small number of participants state that they have not yet experienced AI tools or have no experience in using these technologies. Sample statements are given below;

P₇ : "I haven't used it."

P₁₅ : "No."

P₂₃ : "I have not experienced it."

In the light of the analysis, it is seen that lecturers experience artificial intelligence technologies intensively or to a limited extent for different purposes. Tools such as ChatGPT, Copilot, Canva, Grammarly and Diffit are effectively used in content creation, question preparation, text analysis, learning analytics and visual content preparation. While some participants emphasized that these technologies enrich teaching processes and offer significant advantages in analyzing student performance, participants with limited experience stated that they use AI tools mostly in individual studies and at beginner level. On the other hand, a small number of participants stated that they have not yet experienced AI tools.

The Impact of Artificial Intelligence on Teaching Methods and Materials

The codes collected in this dimension are given under three sub-themes: "Preparation of Instructional Materials and Content Presentation", "Teaching Methods and Interaction", and "Individualized Learning".

Preparation of Instructional Materials and Content Presentation

As a result of the analysis, it was found that the participants' approaches to instructional material preparation and content presentation could be classified into three different categories.

Time Saving: Participants state that artificial intelligence technologies save time by increasing efficiency in preparing instructional materials and presenting content. These tools play a supportive role in content preparation and reduce the workload of instructors by making harmonious arrangements in design, highlighting important information and creating visual materials. In addition, it is emphasized that they offer instructors the opportunity for more strategic and creative work with the ability to summarize and automate long and laborious research processes. It is stated that artificial intelligence tools facilitate access to information for both instructors and students, provide flexibility in teacher-student communication and support learning processes with fast feedback opportunities. It is a general opinion that these technologies make teaching and learning processes more effective and efficient. Related participant statements are presented below;

P₁₂ : "It is important in terms of speeding up production, facilitating accessibility and saving time."

P₁₃ : "Summarizing long and laborious research and literature, saving time."

P₂₅ : "By reducing the routine workload of teachers, it will allow them to work more creatively and strategically."

Content Preparation and Presentation: The analysis reveals that artificial intelligence technologies make significant contributions to content preparation and development of visual materials in teaching processes. Participants stated that AI tools reinforce learning by using animations, simulations and three-dimensional visuals to make course materials more effective and interesting. In addition, it is emphasized that AI-supported systems support learning by highlighting 3D visuals in vocabulary teaching, improve written communication skills by giving instant feedback to written paragraphs and articles, and support speaking skills. The instructors state that artificial intelligence helps them to select compatible colors and highlight important content without worrying about design in the content creation process, thus saving time in making formal arrangements. Some of the statements on the subject are given below;

P₂ : "Artificial intelligence has not changed much in the way I teach, but it is very helpful in preparing content. It also does a very good job of selecting harmonious colors or highlighting important content without worrying about design, thus saving me a lot of time in making formal edits to the content I prepare."

P₂₈ : "It will be useful in many areas such as emphasizing 3D visuals in vocabulary teaching, reinforcing learning, giving instant feedback to the paragraphs and articles you write, supporting speaking skills, etc."

P₃₁ : "With AI-powered tools, animations, simulations or visualizations can be prepared for complex topics, making the content more engaging."

Content Richness: When the data are analyzed, it is understood that artificial intelligence technologies make significant contributions to enriching instructional materials and content production. Participants state that artificial intelligence tools provide content richness in areas such as question generation, translation, narration and question-answer and support creativity in material production. They also state that AI-supported systems save time in the processes of preparing exam questions and supporting them with visual materials and make course materials more dynamic and interesting. Lecturers emphasize that AI tools can provide personalized learning experiences thanks to their capacity to monitor student progress and adjust course content according to student needs. Sample statements reflecting the views of the participants are presented below;

P₆ : "It provides content richness in areas such as question generation, translation, narration, question-answer. It also supports creativity in producing materials."

P₉ : "Sometimes I have my exam questions prepared by artificial intelligence and make changes on them. I enrich the teaching materials by supporting them with visual materials."

P₁₉ : "Artificial intelligence contributes to enriching course content with chat, visual production, assistance, evaluation, data analysis and text production."

Participants stated that artificial intelligence technologies reduce the workload of instructors by increasing efficiency in preparing instructional materials and presenting content. AI tools make course materials more effective and interesting by using animations, simulations and three-dimensional visuals, reinforce learning by emphasizing 3D visuals in vocabulary teaching, and improve written communication skills by providing instant feedback on written paragraphs. In addition, AI-supported systems save time in preparing exam questions, editing content and creating visual materials, and help instructors to choose compatible colors and highlight important content without design concerns. By summarizing and automating long and laborious research processes, these tools provide instructors with the opportunity for more strategic and creative work, while offering personalized learning experiences thanks to their capacity to monitor student progress and tailor course content to student needs.

Teaching Methods and Interaction

The analysis revealed that the participants' views on teaching methods and interaction approaches can be grouped under three different categories.

Interactive Learning Environments: When the statements are evaluated, it is understood that artificial intelligence-supported technologies make educational environments more interactive and dynamic by supporting student-centered learning processes. Instructors state that AI-based video, simulation, virtual and augmented reality tools make learning materials more participatory and interesting. They also emphasize that these technologies improve student-teacher and student-student communication through digital platforms in a more flexible and dynamic way. They support more interactive and student-oriented classroom environments by reducing teacher talk time, thus making learning processes more efficient and effective. However, some participants expressed concern that digital interactions may limit human interaction by replacing face-to-face communication and in-depth discussions. Sample statements from the participants' views are presented below;

P₆ : "It can make it more interactive."

P₁₆ : "AI-based video or simulations can be used in the presentation of content, making learning materials more interactive. In the interaction structure, student-teacher and student-student communication becomes more dynamic through digital platforms. However, the replacement of face-to-face communication and in-depth discussions with AI-supported tools in this process may limit human interaction."

P₂₈ : "Artificial intelligence will make the way I teach more interactive. More interaction can be achieved by using smart learning platforms to increase student engagement. A structure can be created that allows students to learn at their own pace."

Changing the Role of the Teacher: When the codes are analyzed, it is observed that the opinions of the lecturers are gathered in the direction that artificial intelligence technologies transform the role of teachers from knowledge transmitter to facilitator and guide of the learning process. In this context, it is stated that teachers will assume a more strategic guidance role with the change in both the content and form of education with artificial intelligence tools. AI has enabled teachers to shift from leadership roles to facilitator positions, enabling them to focus on each student individually, not just the whole class. It is also emphasized that teachers have evolved into a more supportive role by using AI tools to explain complex topics in a simpler way and guide students. This transformation also contributes to supporting student-centered learning environments. Sample statements related to this dimension are presented below;

P₁₅ : "Artificial intelligence will change both the content and the form of education. Teachers may have to take on a more strategic guidance role."

P₁₇ : "It turns the teacher from a leader into a facilitator, able to address each student personally, not just the whole class."

P₃₁ : “Teachers will evolve into a more supportive role, using AI tools to explain complex subjects in a simpler way and guide students.”

Instant Feedback: In the participant statements, it was observed that artificial intelligence technologies make learning processes more effective and efficient by providing instant and customized feedback to students according to their performance. According to the opinions of the lecturers, AI-supported systems can quickly detect the mistakes made by students and provide instant feedback to them, thus supporting their learning processes. In addition, it is stated that artificial intelligence tools are useful in improving students’ written communication skills by providing instant feedback on written paragraphs and articles and support their speaking skills. Teachers gain more time in the teaching process through systems that can answer students’ questions instantly thanks to artificial intelligence, and they can use this time to provide more support for students’ individual needs. In general, the participants stated that artificial intelligence technologies strengthen student-teacher interaction and transform learning experiences by making teaching processes more dynamic and personalized. In the light of the data, sample statements reflecting the views of the participants are presented below;

P₂₀ : “AI-powered systems can quickly detect student mistakes and provide immediate feedback.”

P₂₈ : “Artificial intelligence will be useful in many areas such as giving instant feedback to written paragraphs, articles and supporting speaking skills.”

P₃₂ : “Thanks to artificial intelligence, systems that can answer students’ questions instantly allow me to save more time in the teaching process.”

The data obtained reveal that artificial intelligence technologies make learning environments more interactive and student-centered. These technologies enrich learning processes and increase the active participation of students by developing student-teacher and student-student communication in a more flexible and dynamic way through digital platforms. Moreover, artificial intelligence tools enable teachers to shift their role from knowledge transmitter to facilitator and guide of the learning process, enabling them to move to a more strategic and supportive position. This transformation enables teachers to explain complex topics in a simpler way and provide feedback customized to the individual needs of students. As a result, AI technologies strengthen student-teacher interaction and transform learning experiences by making teaching processes more dynamic, personalized and efficient.

Individualized Learning

The analysis revealed that the Personalized and Individualized Learning dimension can be handled in three separate categories.

Student-Centered Learning: In the light of data analysis, it is seen that AI-supported technologies transform educational environments by supporting student-centered learning processes. Instructors state that AI tools make learning experiences more effective by providing customized content suitable for students’ individual needs. They also state that AI technologies allow teachers to shift from leadership roles to facilitator positions, enabling them to take a more active role in students’ learning processes. Instructors emphasize that these technologies support more interactive and student-oriented classroom environments by reducing teachers’ speaking time, thus making learning processes more efficient and effective. In general, it is widely expressed that artificial intelligence technologies make significant contributions to the development of student-centered learning environments. Some examples of the participants’ statements are as follows;

P₁₇ : “Artificial intelligence turns the teacher from a leader to a facilitator by respecting the interests and abilities of the individual, instead of desks facing a lectern in the classroom, in the laboratory and in the classroom, it can address each student personally, not just the whole class.”

P₂₈ : “The teacher has reduced speaking time and made children more active in the learning process. Traditional teacher roles have now changed, supporting a student-centered interactive classroom environment.”

P₃₂ : “Artificial intelligence can make learning processes more effective by providing content customized to students’ needs.”

Adaptation to Individual Learning Speed: When the codes collected in this dimension are analyzed, it is seen that artificial intelligence technologies make learning processes more effective and efficient by adapting to the individual learning speed of students. Instructors state that AI-supported systems support independent learning by providing immediate and customized feedback based on students’ performances and allow students to manage their own learning processes. It is also emphasized that AI tools monitor student progress and provide content suggestions, thus helping to organize course content according to student needs. It is stated that teachers gain more time in the teaching process through systems that can answer students’ questions instantly thanks to artificial intelligence and that they can use this time to provide more support for students’ individual needs. Some participant statements regarding this situation are as follows;

P₁₇ : “It can take on an important role that evolves towards a role that delivers personalized instruction, designs and selects instruction, monitors student progress and provides support.”

P₂₉ : “Artificial intelligence will make teaching processes more facilitative. Providing content customized to students’ needs will enrich their learning experience.”

P₃₁ : “In the future, students can have learning experiences customized to their own pace and needs and learn the field more effectively.”

Content According to Individual Needs: Participants emphasized the capacity of artificial intelligence technologies to personalize teaching processes. These tools are said to make learning experiences more effective and efficient by providing materials suitable for students' interests, learning styles and individual paces. Artificial intelligence-based tools are said to make significant contributions to teaching processes by monitoring student progress and providing support. Moreover, thanks to automated assessment and feedback systems, they reduce the workload of teachers and allow them to take on more strategic and guidance-oriented roles. In general, it is emphasized that artificial intelligence tools improve students' independent learning skills and contribute to teachers' implementation of more effective teaching methods. Sample participant statements are given below;

P₂₅ : "Artificial intelligence personalizes educational processes and provides content that is suitable for the learning pace and style of each student. It also allows teachers to develop more effective teaching methods by reducing their workload thanks to automatic evaluation and feedback systems."

P₂₉ : "Artificial intelligence will make teaching processes more facilitative. Providing content customized to students' needs will enrich their learning experience."

In the light of the analysis, it emerges that artificial intelligence technologies have significantly transformed educational processes. AI tools make learning experiences more effective and efficient by providing customized content tailored to students' individual needs, learning speeds and interests. These technologies enhance student-teacher and student-student interactions in a more flexible and dynamic way through digital platforms and support the transition of teachers from knowledge transmitter to facilitator and guide-oriented positions. In addition, artificial intelligence-supported systems monitor students' performance and provide instant and personalized feedback, encouraging independent learning. Thanks to automated assessment and feedback mechanisms, teachers' workload is reduced, allowing them to develop more strategic and effective teaching methods. In general, it is widely shared among the participants that artificial intelligence technologies support student-centered learning environments, adapt to individual learning pace and contribute to more efficient and effective work of teachers.

The Impact of Artificial Intelligence on Student Learning and Development Processes

The codes collected under the theme of the Impact of Artificial Intelligence on Student Learning and Development Processes are distributed under two sub-themes: "Impact on Students' Learning Process" and "Thinking and Problem Solving Skills".

Impact on Students' Learning Process

The analysis showed that the dimension of Students' Impact on the Learning Process can be analyzed under three different categories.

Easy Access to Information: In the participant statements, it was seen that the opinions of the lecturers focused on the fact that artificial intelligence technologies accelerate learning processes by providing fast and easy access to information. It is stated that artificial intelligence tools make learning experiences more effective by facilitating research processes and providing students with customized content according to their needs. Instructors stated that they support students' learning processes by uploading course content and creating sample exam questions. However, some participants expressed concern that the rapid access to information may lead students to AI without questioning and cause readiness. In general, the fact that artificial intelligence facilitates access to information and supports learning processes is considered as an important innovation and opportunity in education. Some of the codes that emerged in this dimension are presented below;

P₃ : "It has made it much easier to access information."

P₈ : "It has made it much easier to access information. However, it may accustom some people to readiness. I don't find it right to resort to it directly without questioning and reading."

P₁₃ : "It can facilitate research and provide faster access to information."

P₂₂ : "It can help students prepare sample exam questions and generate answers by uploading the course content."

Learning Motivation: Participants emphasized the potential of AI technologies to increase learning motivation. In particular, it is emphasized that AI can positively affect motivation by providing personalized assignments and content that are suitable for students' interests and learning styles. It is a general opinion that artificial intelligence tools should be used in an effective and balanced manner. Some codes that emerged in this dimension are presented below;

P₂₉ : "Artificial intelligence will allow personalization of assignments. Creating customized assignments based on students' interests and learning styles can increase their motivation."

P₃₂ : "Artificial intelligence can increase students' motivation by allowing them to learn at their own pace."

Individual Study Opportunity: Participants state that artificial intelligence technologies support students' self-learning skills by increasing their individual study opportunities. It is emphasized that these technologies appeal to students' interests and enrich their educational experiences by providing customized materials. In addition, AI tools are said to help students upload course content and prepare exam questions or generate answers. In general, the view that AI personalizes individual learning processes, increasing responsibility for learning and enabling students to learn more independently comes to the fore. Some of the statements that emerged in this dimension are presented below;

P₁₆ : "The most important change of artificial intelligence technologies in higher education is that they can personalize learning processes and provide an educational experience that is more tailored to the individual needs of each student."

P₁₇ : "Artificial intelligence can address students personally. Nowadays there are many ways to communicate with students through technological applications."

P₂₂ : "It can help students prepare sample exam questions and generate answers by uploading the course content."

It is stated that artificial intelligence technologies make significant contributions to students' learning processes. These technologies accelerate learning processes by providing quick access to information and ease of research, and increase motivation through personalized content and customized assignments. It is stated that artificial intelligence-supported systems that allow students to learn at their own pace improve individual study skills. While artificial intelligence makes learning processes more flexible and individualized, the importance of using it in a conscious and balanced way is emphasized.

Thinking and Problem Solving Skills

The analyses revealed that the participants' evaluations of their thinking and problem solving skills can be categorized under three different categories.

Decrease in Critical Thinking and Problem Solving Skills: Participants expressed concerns about the negative effects of artificial intelligence technologies on students' critical thinking and problem solving skills. In particular, it is stated that the development of these skills may be negatively affected by excessive automation. Participants stated that AI-based assignments may lead to a regression in thinking and problem solving skills by enabling students to complete assignments without any effort. In general, it is widely shared among the participants that the convenience provided by artificial intelligence can weaken critical thinking and problem solving skills by directing students to ready-made solutions. Some statements regarding this situation are given below;

P₁₆ : "Excessive reliance on automation can negatively affect the development of students' critical thinking and problem solving skills."

P₁₇ : "Artificial intelligence is the savior of my homework assignments. Most of the students have their homework done by artificial intelligence. It has both advantages and disadvantages in terms of developing students' problem solving skills. Thinking and problem solving skills may regress while students are trying to find the easy way out."

P₂₇ : "I have some concerns about how AI might affect the development of critical thinking skills."

Decline in Creativity: Participants expressed concern that AI technologies may weaken students' creative and original thinking skills. The fact that artificial intelligence tools allow students to obtain quick and easy solutions without effort may prevent them from developing their ability to generate their own ideas and be creative. This situation may make it difficult for students to use their thinking processes, direct them to ready-made solutions and cause their thinking skills to regress. At this point, it will be necessary for teachers to support students with assignments aimed at revealing these skills. Sample participant statements are presented below;

P₁₅ : "I think that assignments will start to be given more often where the student will have to take the context into account, where he/she will have to show his/her creativity and individual perspective."

P₂₂ : "Students may lose the ability to generate their own ideas and be creative."

P₂₃ : "It affects negatively in the following way: It prevents students from using their thinking skills and directs them to ready-made products that are not their own labor."

Laziness and Habituation to Ease: The statements express concerns that artificial intelligence technologies may lead to laziness and simplicity in students. It is emphasized that students may face difficulties in generating their own ideas and developing their creativity skills because artificial intelligence technologies provide students with quick and easy solutions. This situation may make it difficult for students to use their thinking processes, direct them to ready-made solutions and cause them to produce less reasoned work in their assignments. In addition, it is emphasized that as a result of easy access to information, some students may directly resort to artificial intelligence without questioning and in-depth examination, thus getting used to preparedness. Sample statements regarding the given dimension are given below;

P₇ : "It encourages students to simplify."

P₈ : "It has made it much easier to access information. However, it can accustom some people to readiness. I don't find it right to resort to it directly without questioning and reading."

P₁₄ : "They prepare assignments in which students do less reasoning."

Participants state that the overuse of artificial intelligence technologies can have negative effects on students' cognitive skills. In particular, it is emphasized that basic skills such as critical thinking, problem solving and creativity may weaken due to the ready-made solutions offered by artificial intelligence. It is stated that this situation may lead students to laziness and simplicity and passivate their learning processes. In addition, there is a concern that outsourcing assignments entirely to artificial intelligence may lead to originality and ethical problems. However, some participants stated that AI tools can support creative processes by broadening students' perspectives. There is a consensus that artificial intelligence should be used consciously and in a balanced way in education, otherwise students' cognitive and creative skills may regress.

The Impact of Artificial Intelligence on Measurement and Evaluation Processes

In this section, the effects of artificial intelligence technologies on assessment and evaluation processes are examined. In this context, the relevant codes are analyzed in three sub-dimensions: “Academic Integrity and Ethical Issues”, “Changes in Assessment Methods” and “Exam and Assignment Preparation Processes”.

Academic Integrity and Ethical Issues

The analysis revealed that the evaluations on academic integrity and ethical problems can be handled under four different categories.

Risk of Cheating and Plagiarism: Participants expressed concern that artificial intelligence technologies may increase the risk of cheating and plagiarism in assessment processes. It is emphasized that students may exhibit unethical behaviors by using artificial intelligence, especially in remote and uncontrolled environments; using the content prepared with artificial intelligence without questioning it may negatively affect the reliability of the evaluation processes and the accuracy of the results. In addition, it is stated that the fact that artificial intelligence tools provide students with easy solutions may have negative effects on academic honesty and learning processes by weakening their originality and creativity skills. Sample statements on the subject are presented below;

P₂ : “It may cause problems in remote and uncontrolled exams.”

P₁₆ : “Under the current exam system, it is unlikely to affect exams, but if students are supported by artificial intelligence in online exams, it may cause problems in reliably assessing student performance.”

P₂₅ : “The current situation causes some ethical problems. Students may exhibit unethical behaviors such as cheating or presenting ready-made information.”

Problems of Authenticity: In the light of the analysis, there are concerns that artificial intelligence technologies may have negative effects on students’ originality and creativity skills. It is stated that artificial intelligence tools may lead students to simplicity and cause them to submit works that do not reflect their own thoughts. In addition, it was emphasized that the use of AI-based assignments could jeopardize the reliability of the assessment processes and negatively affect the accuracy of the results. Participants stated that artificial intelligence can be used to enrich the content of assignments, but students’ ability to produce creative and original works may regress if they completely rely on these tools. In this context, it is emphasized that artificial intelligence should be used consciously and responsibly in learning processes. Some of the participant statements related to this dimension are presented below;

P₈ : “Students can make artificial intelligence do the homework I assign. If they use this situation skillfully, it may be difficult for me to understand. This is a very problematic situation in terms of the reliability of the results.”

P₂₃ : “It has prevented me from conducting an exam in the form of written term papers.”

P₂₅ : “Artificial intelligence tools that offer ready-made solutions can negatively affect students’ originality and creativity.”

P₂₇ : “It can be used to enrich the content of assignments, but it is risky for students to rely entirely on these tools.”

Ethical Awareness: Participants express concern that artificial intelligence technologies may lead to ethical problems in educational processes. The use of AI in assignments and exams may prevent students from developing their own thinking and creativity and may lead to unethical behavior. The use of AI, especially in remote and uncontrolled environments, jeopardizes the reliability of student performance and requires more individualized and tailored design of assignments. Moreover, the fact that AI goes beyond cognitive skills necessitates careful consideration of ethical principles in education and raising ethical awareness. The participants share the view that ethical issues can be minimized through the conscious and responsible use of AI, but unethical use of these technologies may be encouraged among students who lack ethical awareness. Sample statements of the participants’ views are presented below;

P₂ : “They have not explored doing students’ homework with artificial intelligence. However, I think that the advancement of artificial intelligence will require the assignments to be more individualized and tailored to the situation.”

P₁₉ : “All concepts, including education, will have to be reconsidered. Artificial intelligence, which will far exceed human cognitive abilities, is in a different position from the technologies that have been realized so far. In particular, the risks, accuracy levels and compliance with ethical principles of current artificial intelligence technologies should be carefully examined and used by taking this framework into account.”

P₂₂ : “However, it can threaten exam security. In particular, I encounter results such as students creating exams given in the form of homework without planning them themselves and without reviewing the results obtained with artificial intelligence and enriching them with their own thoughts. The student does not even know that this is unethical.”

Academic Integrity Education: The statements underline the need to develop comprehensive academic integrity education programs at universities for students to use AI technologies ethically and responsibly. In this regard, the need to establish and disseminate ethical standards in universities is emphasized. It is also stated that the need for academic integrity education increases the need for responsible use of the conveniences offered by artificial intelligence. Participants state that artificial intelligence affects certain academic disciplines and that trained personnel should be trained to provide technical support for the

correct use of these technologies. Especially in fields such as translation, post-editing processes have gained importance with the impact of artificial intelligence and in this context, trainings focusing on ethical issues should be increased. In addition, it is emphasized that unethical use of artificial intelligence can negatively affect educational processes and therefore, instructors and students should be raised awareness and trained. In this context, it can be said that the view that artificial intelligence can make positive contributions to educational processes when used correctly, but that its unethical use can have negative effects on academic integrity and learning processes is widely shared among the participants. Sample statements selected from the participants' views are presented below;

P₅ : "In our country, there is a need for trained personnel who will provide technical support in this field, not verbal support. Universities need to open course centers that will provide training in this way in many fields."

P₂₀ : "Since it is based on a language model, it directly affects translation and interpreting departments. It speeds up the translation process and causes the field to shift more towards post-editing, that is, post-translation control and correction. At this point, training on artificial intelligence is included in more detail in the existing translation technologies courses and in these courses, training on the effective use of this technology in the classroom, paying attention to issues such as ethics, etc. has started to be provided. It may become increasingly indispensable in learning and teaching processes."

P₂₁ : "When artificial intelligence is used correctly, good results will be obtained in terms of teaching. However, unethical ways of use, such as taking the easy way out, will negatively affect the teaching processes, rather than contributing to development. For this reason, both lecturers and students need to be informed and trained about artificial intelligence."

Participants are concerned that AI technologies may increase the risk of cheating and plagiarism in exams and assignments. In particular, it is stated that the use of artificial intelligence in exams conducted in uncontrolled environments may negatively affect the reliability of evaluation processes and students' skills such as creativity and originality. Participants emphasize the need to raise ethical awareness in the use of artificial intelligence and to promote ethical standards in universities. It is stated that responsible use of artificial intelligence can contribute to education, but unethical use can negatively affect learning processes.

Change in Assessment Methods

As a result of the analysis of the codes collected in this dimension, this sub-dimension is evaluated under two categories.

Alternative Assessment Tools: Participant statements reveal that artificial intelligence offers various advantages in exam and assessment processes. It is stated that artificial intelligence will enable exams to focus on high-level skills and will allow project and problem-based tasks to be used more widely as assessment methods. Platforms integrated into Learning Management Systems make it possible to prepare and administer online exams. In this context, participants agree that artificial intelligence provides flexibility, customization and efficiency in exam processes. Sample user statements in this dimension are given below;

P₁₅ : "In theory, artificial intelligence will enable exams to focus on higher-level skills, and project and problem-based tasks to be used more as assessment methods."

P₁₇ : "With artificial intelligence applications, exams themselves can be made. Many platforms for individualized test applications are also going viral. Exam questions are prepared and applied through these platforms adapted to the Learning Management System. I also conduct online exams with the help of these platforms."

Automated Assessment Systems: Participants emphasized the advantages of artificial intelligence-based automated assessment systems such as speed, accuracy and efficiency in exam and assignment processes. It is emphasized that these systems facilitate the preparation and management of exams, provide fast and accurate exam results, and thus reduce the workload of instructors. In addition, it is stated that artificial intelligence tools accelerate the evaluation of assignments and feedback processes and provide instant feedback to students. In this way, it contributes to a more fair and objective evaluation process and supports learning processes. Sample statements related to this dimension are given below;

P₁ : "It gives more effective results in measurement and evaluation."

P₂₆ : "It can facilitate the preparation and management of exams. Thanks to automated assessment systems, exam results can be provided quickly and teachers' workload can be reduced."

P₃₁ : "It can reduce the workload of professors by providing fast and accurate assessment of exams and provide immediate feedback to students."

P₃₂ : "It can speed up the evaluation of assignments and feedback processes."

Importance of Face-to-Face Assessment: Participants emphasized the importance of face-to-face assessment methods due to exam security and ethical issues. It is emphasized that the use of artificial intelligence can increase the risk of cheating in online exams and negatively affect the assessment processes in terms of reliability. Participants emphasized that written term papers and exams should be conducted in a controllable environment, face-to-face and with certain time-space constraints. In addition, it is stated that the impact of artificial intelligence on paper and pencil exams or portfolio-type assessments is limited, but it is predicted that this situation may change in the future. It is stated that face-to-face assessment methods will be more preferred in order to prevent security and ethical problems that may arise from the use of artificial intelligence. Some of the relevant statements are presented below;

P₂₀ : "It will increase the risk of cheating in online exams and assignments. Face-to-face assessment and evaluation will become more important."

P₂ : "Since the vast majority of exams are face-to-face, the impact of artificial intelligence is not too much these days, but it can cause problems in exams that will be held remotely and cannot be controlled."

P₁₁ : "I take my exams in the form of paper and pencil tests or portfolios, so artificial intelligence has no effect on paper and pencil exams. On the other hand, the scores obtained from in-class activities are given as exam scores. Here, too, artificial intelligence cannot affect it yet. However, it is clearly expected to have an impact in this section in the future."

Exam and Assignment Preparation Processes

Participants state that artificial intelligence tools provide important support in the preparation of exam and homework questions. In addition, it is emphasized that course content can be uploaded to artificial intelligence and customized test applications and customized exam questions can be prepared. It is stated that these tools offer innovative solutions that support students' learning processes. Sample statements under this dimension are given below;

P₆ : "I can have questions prepared the way I want and set limits."

P₉ : "Sometimes I have artificial intelligence prepare my exam questions and make changes to them."

P₂₂ : "It can help students to prepare sample exam questions and produce answers by uploading the content of the course. I think it supports their study skills on this subject."

P₂₈ : "Thanks to artificial intelligence, various assignments can be created for the desired skill for any level (A1, A2, B1, etc.) specified in foreign language education and the answers given can be checked by querying artificial intelligence."

In homework preparation processes, it is stated that artificial intelligence has the potential to increase motivation by providing content suitable for students' interests and learning styles. Especially in areas such as foreign language education, the creation of assignments suitable for different levels by artificial intelligence and controlling their answers offers a more effective learning experience. It is a common opinion that artificial intelligence tools increase efficiency in education by providing personalized content in both exam and homework processes.

DISCUSSION AND CONCLUSION

In this study, lecturers' views on the possible effects of artificial intelligence technologies on their teaching-learning processes were described under four main themes: "Use and Experience Level of Artificial Intelligence Technologies", "Effects of Artificial Intelligence on Teaching Methods and Materials", "Effects of Artificial Intelligence on Student Learning and Development Processes" and "Effects of Artificial Intelligence on Assessment and Evaluation Processes". The opinions and experiences of instructors, who play a key role in the integration of AI technologies into teaching processes, provide important clues in terms of the opportunities offered by these technologies, the challenges encountered and their future potential. These findings are instructive in terms of restructuring teaching methods with an innovative approach, supporting student-centered learning environments and making assessment processes more efficient.

Use of Artificial Intelligence and Level of Experience

According to the research findings, it was observed that the participants used artificial intelligence technologies for different purposes and intensities. Especially tools such as ChatGPT, Google Bard, Canva, Grammarly and Diffit are frequently preferred. These tools are used in processes such as preparing teaching materials, creating content, checking grammar, providing visual support and obtaining information in individual research. It is stated that ChatGPT in particular stands out with its functions such as providing fast information access, producing teaching materials and organizing question-answer activities. Wang et al. (2023) state that students and instructors actively use artificial intelligence tools such as ChatGPT in educational processes. In particular, they draw attention to the potential of these tools to enrich students' learning experiences and improve teaching methods. Chiu et al. (2023) concluded in their study that artificial intelligence makes learning processes more effective by accelerating information access. In addition, the participants stated that they found tools such as Google Bard and Google Gemini effective in lesson planning, translation, academic writing and material development processes.

Visual and presentation tools also play an important role in teaching processes. In particular, tools such as Canva, Midjourney and Gamma are preferred to improve the visual quality of teaching materials and to present lessons more effectively. The use of these tools helps students to understand abstract concepts and focus their attention. Creating creative visuals with Canva's DALL-E integration is said to be useful in enriching the course content and increasing students' motivation. In addition, presentation tools such as Gamma provide important support to instructors in preparing dynamic content. Artificial intelligence tools were also found to make significant contributions to individual study and research processes. In particular, it is stated that tools such as Grammarly and Diffit are effective in grammar and style editing of written texts. Similarly, Nazari et al. (2021) examined the effects of an artificial intelligence-based writing assistant (Grammarly) on graduate students and concluded that artificial intelligence contributed to language learning and writing processes. The participants stated that these tools helped them to edit their texts more professionally by reducing the error rate in their academic writing. Galindo-Domínguez et al. (2024) found that teachers used tools such as Dall-E, MidJourney to create visuals, ChatGPT, Perplexity, Grammarly to create digital content, provide writing

support, and research. These tools help teachers both improve their writing skills and present their content in a more professional and effective way.

It is stated that ChatGPT and Google Bard stand out in the research processes with their functions of fast information acquisition and literature review. Participants stated that these tools accelerated their literature review and enabled them to generate new ideas for theoretical discussions. Similarly, Kumar et al. (2024) addressed the functions of ChatGPT and similar productive artificial intelligence tools in education, especially in information retrieval, literature summarization, and accelerating research processes, and found that these tools accelerate access to information in teaching processes, facilitate the preparation of teaching materials, and enable educators to plan their lessons more effectively.

The level of use of artificial intelligence technologies varies according to user experiences. Intensive users make maximum use of the opportunities provided by artificial intelligence and actively use these tools in content creation, evaluation and visual material preparation processes. For example, it is stated that the materials prepared with Canva, Midjourney and Gamma make a significant difference in teaching processes. On the other hand, limited or beginner users could not fully utilize the potential of artificial intelligence and used these tools for limited purposes in their individual studies. This finding is in line with McGrath et al.'s (2023) finding that instructors need professional development to benefit from artificial intelligence technologies.

In the study, it is seen that artificial intelligence technologies are used at different intensities and for different purposes. Effective use of the tools is critical in terms of accelerating and enriching teaching processes. However, for the effective use of artificial intelligence technologies, professional development programs for instructors should be increased and awareness studies should be conducted. In addition, the different purposes and effects of artificial intelligence tools show the importance of a planned integration of these technologies into educational processes. The study emphasizes that faculty members need continuous professional development opportunities and institutional support provided by universities in order to use artificial intelligence tools effectively. This support enables the efficient and strategic use of technology. Similarly, Dakakni and Safa (2023) emphasize the need to increase awareness and training activities among students and teachers.

The Impact of Artificial Intelligence on Teaching Methods

The findings reveal that artificial intelligence technologies make multifaceted contributions to educational processes and create a significant transformation in key areas such as instructional material preparation, content presentation, teaching methods and individualized learning. Participants state that AI tools save time in course material preparation processes, allowing instructors to focus on more strategic and creative tasks. This shows that AI-supported tools play a functional role in education and make teaching processes more effective and efficient. The findings emphasize the innovative solutions offered by AI technologies, especially in the context of content development and presentation. Participants indicated that tools such as animations, simulations and three-dimensional visuals make course materials more engaging. Such visual and interactive content not only attracts students' attention but also supports their learning process by facilitating the understanding of complex topics. Moreover, the ease of content organization and formal design provided by AI tools eases the workload of instructors and improves the quality of instructional materials. In addition, instructors point out that AI-based tools play an important role in providing content richness. Participants mentioned the contributions of these tools in the processes of preparing exam questions, creating examples and expanding course materials.

Participants state that artificial intelligence-supported technologies make learning environments more interactive and dynamic. In particular, it is stated that tools such as video, simulation and augmented reality increase student-teacher and student-student interaction. Studies in the literature support the findings obtained and reveal the effect of artificial intelligence tools on increasing interaction. In particular, the potential of artificial intelligence technologies to strengthen student interaction and make learning processes more dynamic and effective is frequently emphasized (Dakakni & Safa, 2023; Kumar et al., 2024; Jin et al., 2024). However, some concerns were also expressed in the research that artificial intelligence technologies may limit human interaction in education and reduce face-to-face communication. This situation reveals the need to maintain the balance between digital and human interaction. In addition, it is important that artificial intelligence tools are seen only as a supportive tool and that the basic human dimensions of education are not neglected.

The transformation in teaching methods is another noteworthy dimension of the findings. Artificial intelligence technologies were seen to support the transition of teachers from the role of knowledge transmitters to that of guides and facilitators. Participants emphasized that these technologies help students to participate more actively in the learning process. A review of the literature reveals similar conclusions with the findings obtained. Studies express similar views that the roles of teachers will change with the use of artificial intelligence tools (Jin et al., 2024). The ability to provide instant feedback is a key element of AI tools that supports student learning. Participants emphasized that AI technologies make learning processes more effective and efficient by providing immediate and customized feedback to students based on their performance. These tools allow students to quickly identify their mistakes, recognize their deficiencies and better direct their learning. In the literature, there are studies emphasizing the importance of providing in-depth, immediate and customized feedback to students using artificial intelligence (Liu et al., 2024; Kumar et al., 2024; Alqahtani et al. 2023; Nazari et al., 2021).

The ability of AI tools to provide materials suitable for students' individual learning speeds and needs is among the important findings of this study. The potential of artificial intelligence to provide students with individualized and personalized learning experiences was frequently mentioned by the participants. AI-based tools make the learning process more effective by adapting

to the individual learning speed of students. Participants stated that artificial intelligence allows students to learn at their own pace by customizing learning processes and thus achieves more efficient results. In addition, the participants stated that artificial intelligence supports student-centered learning processes and offers content suitable for the individual needs of each student. Similarly, researches emphasize the use of AI tools for individual learning needs (Alqahtani et al., 2023; Chiu et al., 2023; Dakakni & Safa, 2023; Jin et al., 2024; Galindo-Domínguez et al., 2024). However, in support of the research, it has been observed that the effects of artificial intelligence on individualized learning are widely covered in the literature (Jin et al., 2024; Liu et al., 2024; Galindo-Domínguez et al., 2024; Chiu et al., 2023; Tzirides et al., 2024; Zhao & Yu, 2024).

The Impact of Artificial Intelligence on Student Learning and Development Processes

It is supported by the findings that artificial intelligence technologies accelerate learning processes by providing students with fast and easy access to information. The fact that artificial intelligence tools provide fast access to information, accelerate learning processes and provide customized content are among the important contributions to the use of technology in education. Instructors stated that AI tools facilitate research processes and make learning experiences more effective by providing students with customized content according to their needs. This situation supports students' learning processes with functions such as uploading course content and creating sample exam questions and is considered as an important innovation in education. However, the concerns of some participants that the rapid access of artificial intelligence to information may direct students to these tools without questioning and this may lead to a tendency towards ready-made solutions should not be ignored. While these findings reveal the potential benefits of artificial intelligence in education, they also emphasize the need for a conscious and balanced use of technology.

Findings on learning motivation highlight the potential of AI tools to increase students' motivation by providing content that is relevant to their interests and learning styles. Similarly, Nazari et al. (2021) state that AI tools will increase students' motivation and confidence. It was stated that AI-supported systems that allow students to learn at their own pace improve individual study skills and increase responsibility for learning. This situation enables students to participate more actively in learning processes and reveals the importance of customized learning experiences in education. In the literature, there are findings that artificial intelligence has positive effects on motivation (Chiu et al., 2023). Moreover, it is stated that these tools offer immediate feedback mechanisms that support the processes of evaluating and improving students' performance. The findings that AI technologies support students' self-learning skills by increasing individual study opportunities offer an important advantage in terms of personalization of education. Functions such as students preparing exam questions or generating answers by uploading course content support students' independent learning processes and enrich their educational experiences. These findings suggest that artificial intelligence can contribute to student-centered learning approaches and provide educational experiences that are more suitable for individual learning needs.

Findings on the negative effects of artificial intelligence technologies on students' critical thinking and problem solving skills suggest that excessive automation of technology can hinder the development of these skills. At the same time, it is also stated that artificial intelligence tools accelerate access to information and facilitate research processes. However, there is a concern that such fast and easy access to information may lead students to complete their assignments using AI technology without effort, which may have negative effects on problem solving, creative, original and critical thinking skills. The fact that artificial intelligence tools provide students with quick solutions will enable them to reach the result in an easy way without spending effort. This fast and easy way of reaching the result will not require students to make an effort to produce their own ideas and will push students to be lazy. Easy access to information may lead students to apply to artificial intelligence without questioning and in-depth examination. This will weaken students' sense of academic responsibility and render their learning process passive. Supporting the concerns of lecturers on this issue, Dakakni and Safa (2023) state that the use of artificial intelligence technologies for the purpose of escaping to convenience will cause laziness by negatively affecting critical thinking, creativity and original work skills. In this context, teachers should pay attention to design assignments and activities that support students' creative thinking, critical thinking and problem solving skills. In addition, providing guidance on the correct and useful use of artificial intelligence technologies can support students to benefit from these technologies at the highest level, as well as the development of such skills. Although it is accepted that artificial intelligence has the potential to support creative processes in education, it is of great importance to direct this potential in the right way. Effective use of the opportunities offered by artificial intelligence will support the development of students' critical thinking, problem solving and creativity skills, while minimizing the negative effects of technology. Al Ka'bi (2023) states that with artificial intelligence, more attention should be paid to the development of basic skills such as critical thinking and creative problem solving. Suriano et al. (2025) suggest that teachers can play a fundamental role in guiding students to use AI resources responsibly and consciously, encouraging independent research and supporting the process of critical evaluation of information provided by chatbots.

The Impact of Artificial Intelligence on Measurement and Evaluation Processes

The findings that artificial intelligence technologies may increase the risk of cheating and plagiarism in assessment processes highlight the ethical dimensions of the use of these technologies in education. Especially in remote and uncontrolled exam environments, students are more likely to exhibit unethical behaviors by using artificial intelligence tools. In the participant statements, it was emphasized that the convenience provided by artificial intelligence may encourage students to use it without questioning and this may damage the reliability of the evaluation processes. This finding shows the importance of using artificial

intelligence in education within the framework of ethical standards and control mechanisms. Similarly, Dakakni and Safa (2023) state that the view that artificial intelligence has a high potential to be used by students for unethical purposes such as cheating and plagiarism is defended by educators. Another noteworthy finding is the negative effects of AI technologies on students' originality and creativity skills. Participants stated that artificial intelligence technologies may lead students to simplify and present works that do not reflect their own thoughts. This may prevent students from developing their creative thinking and problem solving skills. In addition, it was stated that the use of assignments based on artificial intelligence could jeopardize the reliability of the assessment processes and negatively affect the accuracy of the results. In this context, it is necessary to use artificial intelligence in learning processes in a conscious and responsible manner. Participants have serious concerns that artificial intelligence technologies may lead to ethical problems in educational processes. The use of artificial intelligence in homework and exams may prevent students from developing their own thinking and creativity and may pave the way for unethical behaviors. The use of artificial intelligence, especially in remote and uncontrolled environments, threatens the reliability of student performance and requires more individualized and case-specific design of assignments. This finding emphasizes the importance of raising ethical awareness and promoting ethical standards in education. The findings are in line with the results obtained by Nazari et al. (2021) on the effects of AI on academic integrity and are in line with the recommendations given by McGrath et al. (2023) to promote the ethical use of AI. Furthermore, Chiu et al. (2023) emphasize that AI can pose ethical challenges and therefore needs to be managed responsibly. Considering the potential for AI to cause ethical issues in educational processes, participants stated that comprehensive academic integrity training programs should be developed in universities. In this context, the establishment and dissemination of ethical standards is critical to ensure the responsible use of AI. It was also stated that trained personnel should be trained to provide technical support for the proper use of AI. These suggestions reveal the necessity of creating the necessary infrastructure for the effective and ethical use of artificial intelligence technologies in education. Similarly, Al Ka'bi (2023) states that in addition to increasing awareness and training activities among students and teachers, solutions to the ethical problems of artificial intelligence should be developed. Tzirides et al. (2024) state that the results of their research reveal the necessity of integrating comprehensive AI education into the curriculum so that future generations of students will be equipped with the necessary knowledge, skills and ethical framework to use AI responsibly and innovatively.

The advantages offered by artificial intelligence technologies in examination and assessment processes lead to significant changes in assessment methods. Participants stated that artificial intelligence will enable exams to focus on higher level skills, allowing project and problem-based tasks to be used more widely as assessment methods. Furthermore, the integration of AI into learning management systems has made it possible to prepare and administer online exams. These findings show that artificial intelligence provides flexibility, customization and efficiency in assessment processes and contributes to the adoption of innovative assessment methods in education. The advantages of AI-based automated assessment systems such as speed, accuracy and efficiency in exam and assignment processes also have an important place. Despite the advantages of automated assessment, the findings raise concerns that the use of artificial intelligence may increase the risk of cheating in online exams and negatively affect the reliability of assessment processes, emphasizing the importance of face-to-face assessment methods. Kumar et al. (2024) emphasize the potential of language models such as ChatGPT to enhance automated assessment and personalized learning processes, while Burrows et al. (2015) highlight the importance of automated assessment tools for quick and objective assessment of exams and assignments. Similarly, Alqahtani et al. (2023) mention the advantage of artificial intelligence for automatic assessment in their study.

The support provided by artificial intelligence technologies in the preparation of exam and homework questions brings important innovations in educational processes. Participants stated that artificial intelligence can prepare customized test applications and customized exam questions by uploading course content. It was stated that these tools offer innovative solutions that support students' learning processes. In addition, it was emphasized that artificial intelligence is effective in creating assignments suitable for different levels and checking answers in areas such as foreign language education. These findings show that artificial intelligence increases efficiency in education by providing personalized content in exam and homework preparation processes. The personalized content provided by artificial intelligence in homework preparation processes has the potential to increase students' motivation by providing assignments suitable for their interests and learning styles. This shows that artificial intelligence contributes to adaptive learning processes in education and can provide educational experiences that are more suitable for students' individual learning needs.

The effects of artificial intelligence on assessment and evaluation processes present both opportunities and challenges. While academic integrity and ethical issues represent the major drawbacks of AI in assessment processes, the advantages offered by alternative assessment tools and automated assessment systems reveal the potential benefits of AI in education. Moreover, the support provided by artificial intelligence to exam and homework preparation processes increases efficiency and personalization in education. Therefore, the effective and balanced use of artificial intelligence technologies in education, together with the establishment of ethical standards and supervision mechanisms, can ensure that educational processes are both efficient and ethically reliable.

RECOMMENDATIONS

In line with the findings of this study, several suggestions can be offered to increase the integration of artificial intelligence technologies into educational environments and to ensure their effective use. First of all, comprehensive training programs should

be organized for educators to improve their knowledge and skills on artificial intelligence. These programs should aim to raise awareness about how to use artificial intelligence tools, how to integrate them into educational processes, and ethical issues. Educational institutions should establish clear ethical principles and academic integrity policies regarding the use of AI and communicate these policies to both faculty and students. Academic integrity training should be provided to prevent unethical use of artificial intelligence tools by students. In this way, problems such as cheating and plagiarism can be reduced. To support personalized learning, investments should be made in AI-based adaptive learning systems. These systems can enrich learning experiences by providing content that is tailored to students' individual needs, learning styles and pace. Strategies should be developed to encourage the use of AI tools for students to develop self-directed learning skills. Education programs should include more activities that support critical thinking, problem solving and creativity. Instructors should design assignments and projects to develop these skills so that the facilities offered by artificial intelligence do not negatively affect students' thinking processes. It is important to use artificial intelligence tools as a supportive tool, but not to prevent students from generating original ideas. AI-supported interactive platforms and tools can be used to create interactive and student-centered learning environments. In this way, teachers can be freed from routine workload and focus on more strategic and creative work, while students can participate more actively. In addition, institutions need to make the necessary investments to strengthen the technological infrastructure and facilitate access to AI tools. Alternative assessment methods should be adopted to reduce the ethical problems that arise in assessment and evaluation processes. Methods such as project-based assessments, oral exams and in-class applications can minimize the possible negative effects of using artificial intelligence. In addition, using AI-supported automated assessment systems can reduce the workload of instructors and provide faster feedback to students. Finally, it is important to continuously monitor and evaluate the impact of AI technologies in education. For this purpose, collaboration between educators, researchers and technologists should be encouraged and current developments and best practices should be shared. Thus, the integration of artificial intelligence into educational processes can be realized more effectively and efficiently, and students' learning and development processes can be supported.

In the light of research findings, several suggestions can be made for future academic studies. First of all, it would be useful to conduct longitudinal studies to evaluate the long-term effects of the integration of artificial intelligence technologies into educational processes. In particular, the number of studies that examine the effects of artificial intelligence on students' critical thinking, problem solving and creativity skills in depth should be increased. In addition, research can be conducted to develop ethical awareness regarding the use of artificial intelligence and to evaluate the effectiveness of academic integrity policies. A comparative examination of the integration of artificial intelligence in different disciplines and educational levels will contribute to the determination of effective use strategies of these technologies. Finally, qualitative and quantitative research evaluating the effects of AI-supported teaching methods on student motivation, learning experiences and teacher-student interaction is recommended.

Declaration of Conflicting Interests

The study was conducted and reported by the researcher herself on each stage.

Funding

The author received no financial support for the research, author-ship, and/or publication of this article.

Statements of publication ethics

I hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported by the researcher herself on each stage.

Ethics Committee Approval Information

The required ethics committee permission for the study was obtained from the committee by the researcher.

Ethics Committee Name: Pamukkale University Social and Human Sciences Scientific Research and Publication Ethics Committee

Decision Date: 25.11.2024

Number: 68282350/2024/22

REFERENCES

- Alqahtani, T., Badreldin, H. A., Alrashed, M., Alshaya, A. I., Alghamdi, S.S., bin Saleh, K., Alowais, S. A., Alshaya, O. A., Rahman, I., Al Yami, M. S. & Albekairy, A. M. (2023). The emergent role of artificial intelligence, natural learning processing, and large language models in higher education and research. *Research in Social and Administrative Pharmacy*, 19(8), 1236-1242. <https://doi.org/10.1016/j.sapharm.2023.05.016>

- Al Ka'bi, A. (2023). Proposed artificial intelligence algorithm and deep learning techniques for development of higher education. *International Journal of Intelligent Networks*, 4, 68-73. <https://doi.org/10.1016/j.ijin.2023.03.002>
- Buchanan, B. G., & Feigenbaum, E. A. (1978). Dendral and meta-dendral: their applications dimension. *Artificial Intelligence*, 11(1-2), 5-24. [https://doi.org/10.1016/0004-3702\(78\)90010-3](https://doi.org/10.1016/0004-3702(78)90010-3)
- Burmeister, J. K. (2023). Education for a post-work society: AI, the liberal arts and the future of leisure. In D. Araya & P. Marber (Eds.), *Augmented education in the global age* (pp. 172-187). Routledge.
- Burrows, S., Gurevych, I., & Stein, B. (2015). The eras and trends of automatic short answer grading. *International Journal of Artificial Intelligence in Education*, 25(1), 60-117. <https://doi.org/10.1007/s40593-014-0026-8>
- Büyüköztürk, Ş., Akgün, Ö. E., Karadeniz, Ş., Demirel, F. ve Kılıç, E. (2013). *Bilimsel araştırma yöntemleri*. Pegem Akademi.
- Campbell, M., Hoane Jr., A. J., & Hsu, F. H. (2002). Deep blue. *Artificial Intelligence*, 134(1-2), 57-83. [https://doi.org/10.1016/S0004-3702\(01\)00129-1](https://doi.org/10.1016/S0004-3702(01)00129-1)
- Chiu, T.K.F., Xia, Q., Zhou X., Chai, C.S., & Cheng, M. (2023). Systematic literature review on opportunities, challenges, and future research recommendations of artificial intelligence in education. *Computers and Education: Artificial Intelligence*, 4, 100118. <https://doi.org/10.1016/j.caeai.2022.100118>
- Dakakni, D., & Safa, N. (2023). Artificial intelligence in the L2 classroom: implications and challenges on ethics and equity in higher education: a 21st century Pandora's box. *Computers and Education: Artificial Intelligence*, 5, 100179. <https://doi.org/10.1016/j.caeai.2023.100179>
- Enslin, S., & Kaul, V. (In Press). Past, present, and future: a history lesson in artificial intelligence. *Gastrointestinal Endoscopy Clinics of North America*, <https://doi.org/10.1016/j.giec.2024.09.003>
- Fayyad, U., Piatetsky-Shapiro, G., & Smyth, P. (1996). From data mining to knowledge discovery in databases. *AI Magazine*, 17(3), 37-54. <https://doi.org/10.1609/aimag.v17i3.1230>
- Galindo-Domínguez, H., Delgado, N., Campo, L., & Losada, D. (2024). Relationship between teachers' digital competence and attitudes towards artificial intelligence in education. *International Journal of Educational Research*, 126, 102381. <https://doi.org/10.1016/j.ijer.2024.102381>
- Grzybowski, A., Pawlikowska-Lagód, K., Lambert, W.C., & Edin, F. (2024). A history of artificial intelligence. *Clinics in Dermatology*, 42(3), 221-229. <https://doi.org/10.1016/j.clindermatol.2023.12.016>
- Jin, Z., Goyal, S. B., & Rajawat, A.S. (2024). The informational role of artificial intelligence in higher education in the new era. *Procedia Computer Science* 235, 1008-1023. <https://doi.org/10.1016/j.procs.2024.04.096>
- Joo, K. H., & Park, N. H. (2024). Teaching and learning model for artificial intelligence education. *Procedia Computer Science* 239, 226-233. <https://doi.org/10.1016/j.procs.2024.06.166>
- Krizhevsky, A., Sutskever, I., & Hinton, G. E. (2012). ImageNet classification with deep convolutional neural networks. *Proceedings of the 25 th International Conference on Neural Information Processing Systems*, 1, 1097-1105. https://proceedings.neurips.cc/paper_files/paper/2012/file/c399862d3b9d6b76c8436e924a68c45b-Paper.pdf
- Kumar, S., Rao, P., Singhanian, S., Verma, S., & Kheterpal, M. (2024). Will artificial intelligence drive the advancements in higher education? a tri-phased exploration. *Technological Forecasting & Social Change*, 201, 123258. <https://doi.org/10.1016/j.techfore.2024.123258>
- Laupichler, M. C., Aster, A., Schirch, J., & Raupach, T. (2022). Artificial intelligence literacy in higher and adult education: a scoping literature review. *Computers and Education: Artificial Intelligence*, 3, 100101. <https://doi.org/10.1016/j.caeai.2022.100101>
- LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. *Nature*, 521, 436-444. <http://doi.org/10.1038/nature14539>
- Liamputtong, P. (2019). *Qualitative Research Methods*, 5th edition. Oxford University Press.
- Liu, Y., Zhang, H., Jiang, M., Chen, J., & Wang, M. (2024). A systematic review of research on emotional artificial intelligence in english language education. *System*, 126, 103478. <https://doi.org/10.1016/j.system.2024.103478>
- Ma, W., Adesope, O. O., Nesbit, J. C., & Liu, Q. (2014). Intelligent tutoring systems and learning outcomes: a meta-analysis. *Journal of Educational Psychology*, 106(4), 901-918. <https://doi.org/10.1037/a0037123>
- Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C., & Hung Byers, A. (2011). *Big data: the next frontier for innovation, competition, and productivity*. McKinsey Global Institute.
- McCarthy, J., Minsky, M. L., Rochester, N., & Shannon, C. E. (2006). A Proposal for the dartmouth summer research project on artificial intelligence, august 31, 1955. *AI Magazine*, 27(4), 12-14. <https://doi.org/10.1609/aimag.v27i4.1904>
- McCorduck, P. (2004). *Machines who think: a personal inquiry into the history and prospects of artificial intelligence*. AK Peters/CRC Press.
- McCulloch, W. S., & Pitts, W. (1943). A logical calculus of the ideas immanent in nervous activity. *Bulletin of Mathematical Biophysics*, 5(4), 115-133. <https://doi.org/10.1007/bf02478259>
- McGrath, C., Cerratto Pargman, T., Juth, N., & Palmgren, P. J. (2023). University teachers' perceptions of responsibility and artificial intelligence in higher education-an experimental philosophical study. *Computers and Education: Artificial Intelligence*, 4, 100139. <https://doi.org/10.1016/j.caeai.2023.100139>
- Mitchell, T. M. (1999). Machine learning and education. *Communications of the ACM*, 42(11), 30-36. <https://doi.org/10.1145/319382.319388>
- Muthukrishnan, N., Maleki, F., Ovens, K., Reinhold, C., Forghani, B., & Forghani, R. (2020). Brief history of artificial intelligence. *Neuroimaging Clinics of North America*, 30(4), 393-399. <https://doi.org/10.1016/j.nic.2020.07.004>
- Nazari, N., Shabbir, M. S., & Setiawan, R. (2021). Application of artificial intelligence-powered digital writing assistant in higher education: randomized controlled trial. *Heliyon*, 7(5), e07014. <https://doi.org/10.1016/j.heliyon.2021.e07014>

- Newell, A., & Simon, H. A. (1956). *The logic theory machine: A complex information processing system*. The RAND Corporation. <https://www.rand.org/pubs/papers/P868.html>
- Newell, A., & Simon, H. A. (1961). *GPS, a program that simulates human thought*. The RAND Corporation.
- Nilsson, N. J. (2009). *The quest for artificial intelligence-a history of ideas and achievements*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511819346>
- Okonkwo, C. W., & Ade-Ibijola, A. (2021). Chatbots applications in education: a systematic review. *Computers and Education: Artificial Intelligence*, 2, 100033. <https://doi.org/10.1016/j.caeai.2021.100033>
- Oliveira, A. L., & Figueiredo, M. A. T. (2023). Artificial intelligence: historical context and state of the art. In H. S. Antunes, P. M. Freitas, A. L. Oliveira, C. M. Pereira, E. V. de Sequeira, & L. B. Xavier (Eds.), *Multidisciplinary perspectives on artificial intelligence and the law* (pp. 3-10), Springer.
- Russell, S., & Norvig, P. (2021). *Artificial intelligence: a modern approach (4th ed.)*. Pearson.
- Sargent, T. J. (In Press). Sources of artificial intelligence. *Journal of Economic Dynamics & Control*, <https://doi.org/10.1016/j.jedc.2024.104989>.
- Silver, D., Huang, A., Maddison, C. J., Guez, A., Sifre, L., van den Driessche, G., Schrittwieser, J., Antonoglou, I., Panneershelvam, V., Lanctot, M., Dieleman, S., Grewe, D., Nham, J., Kalchbrenner, N., Sutskever, I., Lillicrap, T., Leach, M., Kavukcuoglu, K., Graepel, T., & Hassabis, D. (2016). Mastering the game of go with deep neural networks and tree search. *Nature*, 529(7587), 484-489. <https://doi.org/10.1038/nature16961>
- Stahl, B. C., Schroeder, D., & Rodrigues, R. (2022). *Ethics of artificial intelligence case studies and options for addressing ethical challenges*. Springer.
- Suriano, R., Plebe, A., Acciai, A., & Fabio, R. A. (2025). Student interaction with ChatGPT can promote complex critical thinking skills. *Learning and Instruction*, 95, 102011. <https://doi.org/10.1016/j.learninstruc.2024.102011>
- Turing, A. M. (1936). On computable numbers, with an application to the Entscheidungsproblem. *Proceedings of the London Mathematical Society*, 2(42), 230-265. <https://doi.org/10.1112/plms/s2-42.1.230>
- Turing, A. M. (1950). Computing machinery and intelligence. *Mind*, 59(236), 433-460. <https://doi.org/10.1093/mind/LIX.236.433>
- Tzirides, A. O., Zapata, G., Kastania, N. P., Saini, A. K., Castro, V., Ismael, S. A., You, Y., dos Santos, T. A., Sears Smith, D., O'Brien, C., Cope, B., & Kalantzis, M. (2024). Combining human and artificial intelligence for enhanced AI literacy in higher education. *Computers and Education Open*, 6, 100184. <https://doi.org/10.1016/j.caeo.2024.100184>
- Weizenbaum, J. (1966). ELIZA-A computer program for the study of natural language communication between man and machine. *Communications of the ACM*, 9(1), 36-45. <https://doi.org/10.1145/365153.365168>
- World Intellectual Property Organization (WIPO). (2024). *Generative artificial intelligence: patent landscape report*. WIPO.
- Wang, S., Wang, F., Zhu, Z., Wang, J., Tran, T., & Du, Z. (2024). Artificial intelligence in education: a systematic literature review. *Expert Systems With Applications*, 252, 124167. <https://doi.org/10.1016/j.eswa.2024.124167>
- Yim, I. H. Y. (2024). A critical review of teaching and learning artificial intelligence (AI) literacy: developing an intelligence-based AI literacy framework for primary school education. *Computers and Education: Artificial Intelligence*, 7, 100319. <https://doi.org/10.1016/j.caeai.2024.100319>
- Zhao, C., & Yu, J. T. (2024). Relationship between teacher's ability model and students' behavior based on emotion-behavior relevance theory and artificial intelligence technology under the background of curriculum ideological and political education. *Learning and Motivation*, 88, 102040. <https://doi.org/10.1016/j.lmot.2024.102040>



| Research Article / Araştırma Makalesi |

An Investigation Of Inclusion Students' Absenteeism From School

Kaynaştırma Öğrencilerinin Devamsızlık Durumlarının İncelenmesi

Şahin CİNCİOĞLU¹, Özgür KURT², Meral DEVECİ³

Keywords

1. Inclusion
2. Special Needs Students
3. Absenteeism
4. Case Study

Anahtar Kelimeler

1. Kaynaştırma
2. Özel Gereksinimli Öğrenciler
3. Devamsızlık
4. Durum Çalışması

Received/Başvuru Tarihi

14.09.2024

Accepted / Kabul Tarihi

25.07.2025

Abstract

Purpose: The aim of this study was to examine the absenteeism status of inclusion students.

Design/Methodology/Approach: The study group consisted of 25 secondary school teachers working in inclusive classes in public secondary schools affiliated with the Ministry of National Education in the central Edirne province in the 2023-2024 academic year. The study was created to use a case study, one of the qualitative research designs. The semi-structured interview technique was used to collect study data and the data obtained was analyzed using the content analysis method.

Findings: According to the results of the study, the teachers stated that inclusion students were mostly absent due to peer bullying and lack of familial attention, that these students had problems adapting to school and that the reason for this was that they had difficulty communicating with their friends, and that the problems in their friendship relationships were due to being excluded by their friends.

Highlights: According to the results obtained, teachers stated that family education and peer education to ensure that the situation of mainstreaming students is accepted by their friends are necessary for the solution of the absenteeism problems of mainstreaming students. Based on the study results, it is recommended that a multidimensional support education model be developed in cooperation with ministries, non-governmental organizations and relevant associations in order to prevent school absenteeism among inclusion students.

Öz

Çalışmanın amacı: Kaynaştırma öğrencilerinin devamsızlık durumlarını incelemektir.

Materyal ve Yöntem: Çalışma grubunu 2023-2024 eğitim-öğretim yılında Edirne ili merkezinde Milli Eğitim Bakanlığı'na bağlı devlet ortaokullarında kaynaştırma sınıflarında görev yapan 25 ortaokul öğretmeni oluşturmaktadır. Çalışma nitel araştırma desenlerinden biri olan durum çalışması kullanılacak şekilde oluşturulmuştur. Çalışma verilerinin toplanmasında yarı yapılandırılmış görüşme tekniği kullanılmış ve elde edilen veriler içerik analizi yöntemi kullanılarak analiz edilmiştir.

Bulgular: Araştırma sonuçlarına göre öğretmenler, kaynaştırma öğrencilerinin en çok akran zorbalığı ve aile ilgisizliği nedeniyle devamsızlık yaptıklarını, bu öğrencilerin okula uyum sorunu yaşadıklarını ve bunun nedeninin arkadaşlarıyla iletişim kurmakta zorlanmaları olduğunu, arkadaşlık ilişkilerindeki sorunların ise arkadaşları tarafından dışlanmalarından kaynaklandığını belirtmişlerdir.

Önemli Vurgular: Elde edilen sonuçlara göre öğretmenler, kaynaştırma öğrencilerinin devamsızlık sorunlarının çözümünü için aile eğitimi ve kaynaştırma öğrencilerinin durumunun arkadaşları tarafından kabul edilmesini sağlayacak akran eğitiminin gerekli olduğunu belirtmişlerdir. Araştırma sonuçlarına dayanarak, kaynaştırma öğrencilerinin okula devamsızlığının önlenmesi için bakanlıklar, sivil toplum kuruluşları ve ilgili derneklerle işbirliği içinde çok boyutlu bir destek eğitim modeli geliştirilmesi önerilmektedir.

¹ Corresponded Author, Ministry of Education, Edirne, TÜRKİYE; <https://orcid.org/0009-0005-7566-3348>

²İstanbul 29 May University, Education Faculty, Department of Special Education, İstanbul, TÜRKİYE; <https://orcid.org/0000-0001-9055-0601>

³ Namık Kemal University, Vocational School of Health Services , Department of Child Development , Tekirdağ, TÜRKİYE; <https://orcid.org/0000-0003-1432-8544>

INTRODUCTION

The school represents a crucial environment for the cognitive, social, and emotional development of children and adolescents. School absenteeism can have significant and adverse consequences, including impaired social and emotional growth, lower academic achievement, the formation of negative habits, and an increased risk of dropping out (Eaton et al., 2008; Chang et al., 2017).

Inclusive education refers to the educational environment that aims to provide the least restrictive environment in which students with special needs can develop their daily life, social, communication, academic, psychological and emotional skills at the highest level by benefiting from supportive education services in the same environment with students with typical development and can continue their lives independently and productively (Batu, 2000; Banks et al., 2017; Jochova et al., 2018).

Although the concept of "inclusion / integration" is used in the regulation on special education services (2018), in the education system implemented in Turkey, students with "moderate" and "severe" level needs continue their education in special education schools, while students with "mild" level special needs are included in "inclusion" education by making necessary arrangements and providing support special education services. In the education system of countries where "integration" is practiced, students with "moderate and 'severe' level special needs also receive education in general education environments as a result of necessary arrangements and adaptations. In this case, considering the system applied in our country, it was deemed appropriate to use the term "inclusion" in our research.

School absenteeism is a significant issue for students with special needs in inclusive schools and classes. Ensuring regular attendance is crucial for the success of inclusive education and for its positive effects on students with special needs to be fully realized. Although research on absenteeism among these students is limited, it is considered a serious problem (Munkhaugen et al., 2017). Studies have shown that students with attention deficit hyperactivity disorder (ADHD), intellectual disability, and other developmental delays experience chronic absenteeism at a rate 1.5 times higher than that of typically developing students (US Department of Education, 2016; Black & Zablotzky, 2018; Theobald et al., 2017).

The definition of "inclusion" extends beyond merely placing students with special needs in inclusive classrooms. Inclusion implies that schools should not only address the social and academic needs of these students but also "create inclusive communities where inequality is not a barrier" (Anderson, 2021). Therefore, inclusive education should offer both individual and social benefits. The success of inclusive education is influenced by attitudes towards students with special needs, their school attendance, and their general acceptance by typically developing students (Teixeira De Matos & Morgado, 2016).

In the literature, "excused" absences are identified as one of the reasons for school absenteeism among inclusion students. These absences often result from health problems and doctor's appointments related to their disabilities. Since these excused absences are typically short and occasional, they tend to have fewer negative consequences (Melvin et al., 2023; Mattson, 2022). On the other hand, "unexcused" absences tend to be linked to stress at home or school (Mattson, 2022; Teasley, 2004; Hoşgörür & Polat, 2015), and represent ongoing difficulties that are likely to worsen without additional support (Mattson, 2022).

If students with special needs are absent from school, there may be deviations in the short-term goals outlined in their individualized education programs, and long-term goals may not be achieved. In other words, absenteeism limits these students' learning opportunities, reduces their motivation due to frustration caused by academic difficulties (Bülbül, 2012), and leads to academic failure. This failure often triggers chronic absenteeism, perpetuating a vicious cycle (Gershenson et al., 2017; Gottfried & Kirksey, 2017).

In addition, students with special needs who experience chronic absenteeism may face exclusion and peer bullying due to inadequate socialization with their peers. Problems in social relationships can exacerbate absenteeism among these students. Those exposed to bullying, experiencing social anxiety, or having difficulty making friends are more likely to avoid school (Salend & Garrik-Duhaney, 1999; Anderson, 2021). A student's school life is defined not only by academic success but also by their psychological and emotional well-being. Issues such as peer conflicts or in-group exclusion can diminish the desire of students with special needs to attend school (Gottfried, 2014; Melvin et al., 2023).

School absenteeism impacts a student's school experiences, academic success, and behavioral issues, with consequences that extend into adulthood (Kearney & Graczyk, 2020). Therefore, it is essential to address the causes of absenteeism, prevent it, and provide appropriate interventions to support students and families.

For inclusion students, it is necessary to address the reasons for absenteeism and provide appropriate support to help them attend classes. Schools often collaborate with parents, teachers, and support staff to develop strategies and interventions aimed at increasing attendance and removing barriers to participation (Taylı, 2008). Enriching lessons with various activities, motivating students, and raising awareness in order to overcome barriers to socialization and decrease incidents of bullying in the classroom can significantly reduce absenteeism (Yıldırım & Dönmez, 2008).

Recent suggestions for reducing absenteeism among inclusion students have focused on improving the school environment, fostering better teacher-student relationships, and promoting socialization, such as involving students in social activity clubs at school (Marvul, 2012; Egalite, 2018). Studies have highlighted the significant impact teachers can have in reducing absenteeism among students with special needs, leading researchers to a consensus on the crucial role of teachers in addressing this issue (Gershenson, 2016).

This study focused on the absenteeism of students with special needs in inclusive education, aiming to address a significant gap in the literature and provide guidance for future research. It seeks to thoroughly examine absenteeism, a critical issue that directly impacts stakeholders and poses a major challenge to achieving the goals of inclusive education.

METHOD

Research Model

In this study, absenteeism among inclusion students was examined using the case study approach, which is a qualitative research method. This method was chosen because it allows for an in-depth exploration of real-life environments, systematic data collection to capture emerging situations, and a detailed examination of the phenomenon under study. Case studies adopt a holistic approach to investigate factors and focus on understanding how they are influenced by the specific situation (Yıldırım & Şimşek, 2016).

Study Group

The study group of the research consists of 25 secondary school teachers working in inclusive education classes with students with intellectual disabilities in secondary schools in the central district of Edirne province in the 2023-2024 academic year. There were 18 female and seven male participants. The study group of the research was obtained by purposive sampling method. Five of the teachers had 0-10 years of professional experience, 13 had 11-20 years, six had 21-30 years, and one had 31 or more years. In terms of educational background, 20 of the teachers had undergraduate degrees, four had graduate degrees, and one had an associate degree. The teachers represented various subject areas: five in elementary mathematics, five in Turkish, five in social studies, four in English, three in science, one in physical education, one in visual arts, and one in guidance. This information about gender, years of experience, educational attainment, and subject areas is shown in Table 1.

Table 1. *Demographic Characteristics*

Gender	N	%
Female	18	72.00
Male	7	28.00
Total	25	100
Years of Employment in the Profession		
0-10 years	5	20.00
11-20 years	13	52.00
21-30 years	6	24.00
31+ years	1	4.00
Total	25	100
Educational Status		
Bachelor's degree	20	80.00
Postgraduate degree	4	16.00
Associate degree	1	4.00
Total	25	100
Subject Area		
Elementary Mathematics	5	25.00
Turkish	5	25.00
Social Studies	5	25.00
English	4	20.00
Science	3	15.00

Physical Education	1	4.00
Visual Arts	1	4.00
Guidance	1	4.00
Total	25	100

Data Collection Tool and Process

The data gathered from the study were collected using a semi-structured interview form developed by the researcher. The semi-structured interview questions were submitted to the review of four experts to ensure internal validity. As a result of the review, the questions used in the research were finalized. Afterwards, a pilot study was conducted with seven teachers in order to measure the functionality of the prepared questions. In order to determine whether the research questions were clear and understandable and whether the answers given by the teachers reflected the answers to the questions, the internal validity of the question items was obtained by four experts, including the researcher and three field experts. The form used in the research consisted of five open-ended questions to determine the reasons for absenteeism among inclusion students, the reasons why inclusion students with absenteeism issues had problems adapting to school, the reasons why these students had problems in friendship relations, the teachers' strategies to overcome this absenteeism, and the teachers' suggestions for overcoming this absenteeism.

Data Analysis

The data obtained from the research were analyzed using the content analysis technique, which aims to organize and interpret similar themes and findings in a manner that enhances the reader's understanding (Yıldırım & Şimşek, 2016). After the semi-structured interview questions were applied, the responses of the teachers to the interview questions were analyzed separately by both the researcher and three field experts. According to the data obtained within the scope of the themes and sub-themes, the issues of "agreement" and "disagreement" were discussed and necessary arrangements were made. Miles and Huberman's (1994) reliability formula was used to calculate the reliability of the study. $\text{Reliability} = \frac{\text{Agreement}}{(\text{Agreement} + \text{Disagreement})}$. According to the results of the calculation, the reliability of the research was calculated as 96%. Reliability calculations above 70% are considered reliable for the research (Miles & Huberman, 1994). In this case, the result obtained from our research is considered reliable.

FINDINGS

Various findings were obtained regarding the reasons for absenteeism among inclusion students. Below are the findings derived from the responses provided by teachers of inclusion students. A number of themes and sub-themes were formulated as a result of the research.

The findings concerning the theme of "reasons for absenteeism among inclusion students" are detailed in Table 2 below.

Table 2. *Reasons for Absenteeism among Inclusion Students*

Reasons for Absenteeism	R	%
Being bullied by peers	8	18.18
Insufficient attention from the family	8	18.18
Fear of being humiliated in class among friends	6	13.64
Unwillingness to study and learn	6	13.64
Difficulties in communicating with their friends	5	11.36
Failure to adapt to school	4	9.09
Experiencing health problems	4	9.09
Having transportation problems	3	6.82
Total answers	44	100

The teachers identified "being bullied by peers" and "insufficient attention from the family" as the most common reasons for absenteeism among inclusion students. According to the responses summarized in Table 2, the theme of "reasons for absenteeism among inclusion students" was categorized into eight sub-themes: "insufficient attention from the family", "being bullied by peers", "difficulties in communicating with friends", "unwillingness to study and learn", "fear of being humiliated in class among

friends", "failure to adapt to school", "experiencing health problems". and "transportation problems". These sub-themes reflected the following statements of the teachers:

T1: Because they experience learning difficulties and fear social humiliation among their peers, and because they often struggle to grasp the topics covered in lessons.

T5: Students with special circumstances often experience a sense of disconnection from everyday life. When their families are not fully aware of this, they may not adequately prioritize or recognize the significance of their school absences.

T6: In general, we do not encounter many problems. However, there is one student with whom we face challenges. The primary reason for absenteeism is often lack of interest from the student's family.

T18: Special needs. Indifference of families. Self-skill deficiencies. Not being able to adapt to school and having problems with their friends. Their vulnerability often makes them targets for bullying by other children. Additionally, difficulties in understanding the lessons contribute to these issues to a lesser extent.

The findings regarding the theme of "reasons for problems adapting to school among inclusion students with absenteeism issues" are outlined in Table 3.

Table 3. *Reasons for Problems Adapting to School among Inclusion Students with Absenteeism Issues*

Reasons for Problems in Adapting to School	R	%
Difficulties in communicating with their friends	16	47.06
Difficulty in adapting to the lessons and the level of the subjects	9	26.48
Teachers' lack of acceptance and interest in students with special needs	2	5.88
Failure to adapt to school rules	2	5.88
Failure to adapt due to special needs	2	5.88
Failure to develop a sense of belonging to the school	2	5.88
The physical environment of the school is not designed for the student with special needs	1	2.94
Total answers	34	100

The teachers identified "difficulties in communicating with their friends" as the most common reason for problems in adapting to school among inclusion students with absenteeism issues. According to the responses summarized in Table 3, the theme of problems adapting to school included the sub-themes of "difficulty in adapting to the lessons and the level of the subjects", "teachers' lack of acceptance and interest in students with special needs", "failure to adapt to school rules", "failure to adapt due to special needs", "failure to develop a sense of belonging to the school", and "the physical environment of the school is not designed for the student with special needs". These sub-themes reflected the following responses provided by the teachers:

T3: Inclusion students may encounter problems integrating due to rejection by teachers and class parents, exclusion by classmates, and physical classroom environments that are not organized to meet their needs.

T8: Inclusion students often experience communication difficulties with their peers, making it challenging for them to establish friendships.

T18: Absent inclusion students often struggle to adhere to school rules and discipline from teachers. They face difficulties in making friends and adapting to lessons, leading to a general sense of not fitting into the school environment. These students frequently experience exclusion and isolation from their peers, which exacerbates their sensitivity and tendency to take minor issues personally.

Table 4 presents the findings related to the theme of the "reasons for problems in friendship relationships among inclusion students with absenteeism issues".

Table 4. *Reasons for Problems in Friendship Relationships among Inclusion Students with Absenteeism Issues*

Reasons for Problems in Friendship Relationships	R	%
Ostracization by friends	10	40.00
Introversion and shyness of students with special needs	7	28.00
Difficulty in expressing themselves	4	16.00

Failure to find common ground with their friends	3	12.00
Negative attitudes of parents of typically developing children	1	4.00
Total answers	25	100

The teachers identified the “ostracization by friends” of students with special needs as the most common reason for problems in friendship relationships among inclusion students with absenteeism issues. As seen in Table 4, the theme related to these problems was categorized into sub-themes including "ostracization by friends", "introversion and shyness of students with special needs", "difficulty in expressing themselves", "failure to find common ground with their friends", and "negative attitudes of parents of typically developing children". These sub-themes reflected the following responses provided by the teachers:

T4: Middle school students often display selfish behavior and may not readily make sacrifices for inclusion students. Emotional students may initially engage with them, but may eventually lose interest. Integration can be challenging, and interpersonal issues among children can exacerbate these difficulties.

T6: Inclusion students generally do not experience problems with their friends. However, they often prefer to remain in the background in social interactions.

T12: Inclusion students can exhibit heightened sensitivity and touchiness compared to their peers, often exaggerating minor issues. They may also demonstrate behaviors that are developmentally below their chronological age.

Table 5 presents the findings regarding the theme of “teachers' strategies to overcome absenteeism among inclusion students”.

Table 5. *Teachers' Strategies to Overcome Absenteeism among Inclusion Students*

Teachers' Strategies	R	%
I contact the family	15	44.12
I teach the subjects according to the level of the student	5	14.71
I make education and training fun	5	14.71
I cooperate with the guidance counselor	4	11.76
I contact the school administration	2	5.88
I make home visits	2	5.88
I am increasing the number of hours I teach in the support room	1	2.94
Total answers	34	100

The teachers primarily stated that they contacted the families of inclusion students to overcome absenteeism issues. As seen in Table 5, the theme of “teachers' strategies to overcome absenteeism among inclusion students” was categorized into the following sub-themes: "I contact the family", "I teach the subjects according to the level of student", "I make education and training fun", "I cooperate with the guidance counselor", "I make home visits", and "I am increasing the number of hours I teach in the support room". These sub-themes reflected the following responses provided by the teachers:

T1: Through special education classes, academic achievement can be increased a little bit. Thus, when they understand the subjects even a little better, their interest in the lessons may increase. When the subjects are taught in accordance with the level of the student, the problem of absenteeism may decrease. This is what I am trying to do.

T3: The family is contacted. The importance of attendance is mentioned. The attempt is made to solve the problem by making education and training fun and trying to organize the classroom environment for that student.

T14: I try to keep interest in the teacher at a high level. I am more interested in the child and make it fun.

T15: I conduct student and parent interviews and home visits.

Table 6 presents the findings regarding the theme of the “teachers' suggestions” for overcoming absenteeism among inclusion students.

Table 6. *Teachers' Suggestions for Overcoming Absenteeism among Inclusion Students*

Teachers' Suggestions	R	%
Families should be trained	7	18.42
The situation of inclusion students should be accepted by their friends	7	18.42
Lessons should be taught according to students' individual needs	5	13.16
Close relations should be established with families	5	13.16
School should be made a more positive environment and inclusion students should be encouraged to attend	4	10.54
Inclusion students should be educated with students at the same level as themselves	3	7.89
The school administration should cooperate	3	7.89
Teachers should be trained	2	5.26
Support education room activities should be expanded	1	2.63
Each school should have at least one special education teacher	1	2.63
Total answers	38	100

The most important suggestions made by the teachers for overcoming absenteeism among inclusion students were that the families should be trained and that the situation of inclusion students should be accepted by their friends. As seen to Table 6, the theme of the "teachers' suggestions" was categorized into 10 sub-themes. These were "acceptance of inclusion students by their peers", "families should be trained", "lessons should be taught according to students' individual needs", "close relations should be established with families", "inclusion students should be educated with students at the same level as themselves", "school should be made a more popular environment and inclusion students should be encouraged to attend", "the school administration should cooperate", "teachers should be trained", "support education room activities should be expanded" and "each school should have at least one special education teacher." These subthemes reflected the following responses provided by the teachers:

T2: First of all, families should be trained. Most parents do not accept their children's situation and absenteeism is one of the simplest problems these children face.

T12: Support should be provided for them to get on better with their classmates and to adapt to school. Help can be obtained from the guidance counselor. Communicating with the family will be useful.

T13: Efforts to integrate them socially should be increased and they should be encouraged to participate in activities and events.

T16: Efforts to help them adapt socially should be increased and they should be encouraged to participate in activities and events.

DISCUSSION

The data collected to examine absenteeism among inclusion students were analyzed in accordance with the research objectives. Statistical tables were constructed for each research objective based on the teachers' feedback, and themes and sub-themes were formulated and interpreted to align with the findings.

In terms of the reasons for absenteeism among inclusion students, teachers highlighted two primary factors: "insufficient attention from the family" and "children being exposed to peer bullying". Aküzüm et al. (2015) emphasized that families who are engaged with their children and cooperate with the school significantly contribute to their children's regular attendance at school. Altinkurt (2008) found that students often miss school as a way of attracting their family's attention or due to excessive pressure, with numerous physical, psychological, and social reasons underlying their absenteeism. In their meta-analysis, Marlow and Rehman (2021) reported that negative communication in the family is a significant factor leading to student absenteeism. Child absenteeism has been linked to parental efforts to keep the child at home or a lack of parental effort to ensure their child's attendance (Totsika et al., 2020). In this instance, the finding from our research that families do not show sufficient interest in absenteeism aligns with other studies. The educational level of families and their perspectives on education influence the behaviors of students. Families should be made aware that school is not only a place for academic development but also important for the socialization of the child. Another finding of the present study was that inclusion students are often absent from school

because they have been exposed to peer bullying. When the literature is examined, there are findings that support these results. Vilaplana-Prieto (2011) examined the relationship between children with special needs, peer bullying, and the related absenteeism rate. The study reported that 80.72% of children with special needs were victims of bullying, which significantly increased the likelihood of school absenteeism. Similarly, Sunera et al. (2012) and Ochi et al. (2020) found that conflict with peers and peer bullying were significantly associated with school absenteeism in children with special needs. Specifically, students with special needs are more at risk of peer bullying than their typically developing peers due to their cognitive, physical, and social vulnerabilities. Students with special needs in inclusive classrooms can become socially isolated if they are not perceived by other students as a "valued member of the class". Therefore, it is important to strengthen socially supportive relationships for these students. Changing environmental factors, educational policies, teacher influence, and peer education are vital in fostering a supportive and inclusive environment (Vilaplana-Prieto, 2011).

The least common reason cited for absenteeism among inclusion students, according to the teachers' responses to the question "What are the reasons for absenteeism among inclusion students?", was transportation issues. Inclusion students often face challenges accessing school due to lack of free transportation provided by the state. However, it is believed that this issue could be alleviated if families prioritize the importance of school attendance. Therefore, addressing absenteeism problems in students necessitates considering the ecology of the education system as a whole and emphasizing the importance of strengthening the family-school-student relationship.

In the responses provided by teachers to the question "What are the reasons for the problems inclusion students with absenteeism issues have adapting to school?", it was consistently noted that these students often face "communication problems with their friends." This challenge is common among all children who do not attend school regularly, affecting their ability to build and maintain relationships with peers and teachers alike. Adaptation, in this context, refers to the student's capacity to establish meaningful connections within their environment and with themselves. The process of adaptation is influenced by various factors including family dynamics, the school environment, and the quality of friendships (Dağ, 2018). Communication difficulties with peers may stem from the cognitive, behavioral, and social limitations experienced by students with special needs.

Difficulties in social interaction, particularly in children with autism spectrum disorder (ASD), can significantly contribute to school absenteeism. Mebostad et al. (2024) highlight that aspects of social engagement are closely linked to school refusal among children with neurodevelopmental disorders like ASD and ADHD. These children may struggle to initiate or participate in social activities, which can exacerbate their reluctance to attend school. Furthermore, Sevim and Atasoy (2020) discuss how behavioral issues among students with special needs can lead to communication challenges with their peers. Effective strategies include preparing students with special needs for social interactions and educating typically developing peers about their classmates' unique needs and behaviors (Batu, 2000).

Among the answers given by the teachers to the question "What are the reasons for the problems in the friendship relations of inclusion students who have absenteeism issues?", the problem of "being excluded by their friends" was mentioned. This exclusion can lead to significant social and behavioral challenges for these students. Baydık and Bakkaloğlu (2009) and Göl (2014) have similarly highlighted that children with special needs are frequently excluded by their classmates in school settings. Tomaskova et al. (2024) identified that 25% of adolescents with autism faced exclusion from their schools, and 15% of these individuals were permanently absent as a result of this exclusionary experience. To mitigate absenteeism among students with special needs, it is crucial for teachers to prioritize and facilitate positive peer communication. Teachers should prioritize peer communication to mitigate absenteeism among students with special needs. Facilitating positive interactions between these students and their peers not only enhances their social integration but also supports their overall adaptation to society (Sullivan et al., 2014; Stiefel et al., 2017; Fleming et al., 2020; Akıncı-Düzel & Girgin-Akın 2024).

It was found that teachers primarily answered the question "What are your strategies for overcoming the problem of absenteeism among inclusion students?" as "communicating with the family". Implementing strategies in which subject teachers assign responsibilities aligned with students' academic strengths or abilities could potentially reduce absenteeism among these students. Uğraş (2018) found that physical education teachers effectively reduced absenteeism among inclusion students by including them in the school's sports team. Yılmaz and Bayar (2020) emphasized the importance of preventing absenteeism among students in special education through cooperation between school, family, and teachers, highlighting its significance in addressing potential issues with these students. Gün (2013) noted that in cases where inclusion students were absent, this issue was reported to the administration, and if deemed necessary, the administration took steps to retrieve the child from home. This intervention was observed to effectively resolve the issue.

In response to the question "What are your suggestions for overcoming absenteeism among inclusion students?", the most common responses were "families should be trained" and "the situation of inclusion students should be accepted by their friends". In line with these findings, there has been renewed emphasis on the importance of providing education to both families and students. Additionally, it has been suggested that positive behavior intervention programs should be developed and implemented in schools. These programs aim to encourage appropriate behavior and prevent antisocial behaviors, thereby promoting acceptance of inclusion students by their peers.

The results of our study are important in terms of determining the reasons for school absenteeism of mainstreaming students, examining the practices and suggestions of teachers to overcome this problem. As a result of the literature studies we conducted in this field, it was concluded that more studies should be conducted.

RECOMMENDATIONS

1. A multidimensional support education model should be developed in collaboration with ministries, non-governmental organizations, and relevant associations to prevent school absenteeism among inclusion students.
2. School-family cooperation should be enhanced to address absenteeism issues among inclusion students.
3. Responsibilities should be assigned to inclusion students based on their abilities and their participation in group activities should be encouraged.
4. Additional reinforcement should be provided in lessons for inclusion students.
5. More social interactions should be facilitated for inclusion students during their free time through clubs, sports, joint activities, projects, etc..
6. Implementing various sanctions by the state on families as a deterrent to absenteeism among inclusion students should be considered and the family's role in this issue should be recognized.
7. Role models should be invited to participate in school activities to inspire inclusion students.
8. In this study, reasons for absenteeism among inclusion students were given from the teachers' perspectives. Obtaining input directly from the inclusion students themselves could provide a clearer understanding of their absenteeism.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

Funding

The authors received no financial support for the research, author-ship, and publication of this article.

Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed Carefully.

Examples of author contribution statements

First Author: Writing – original draft, Methodology, Data curation, Conceptualization.

Second Author: Writing – review & editing, Supervision.

Third Author: Review & editing, Supervision.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

In conducting this research study, we have complied with APA guidelines for the ethical conduct of research. Ethics committee approval for this study was granted by the Istanbul 29 May University Senate Ethics Committee Commission on 06.11.2023, decision number 2023/11-3, unanimously confirming the study's ethical appropriateness.

REFERENCES

- Akıncı Düzel, S., & Girgin Akın, N. (2024). Özel gereksinimli öğrencilere yönelik öğretmen tutumlarının incelenmesi. *Journal of Sustainable Educational Studies (JSES)*, 5(2), 39-53
- Aküzüm, C., Yavaş, T., Tan, Ç., & Uçar, M. B. (2015). İlköğretim kurumu öğrencilerinin devamsızlık ve okul terki nedenleri. *Uşak Üniversitesi Sosyal Bilimler Dergisi*, 8(2), 167-192.
- Allen, C. W., Diamond-Myrsten, S., & Rollins, L. K. (2018). School absenteeism in children and adolescents. *American Family Physician*, 98(12), 738-744.
- Altinkurt, Y. (2008). Öğrenci devamsızlıklarının nedenleri ve devamsızlığın akademik başarıya olan etkisi. *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi*, (20), 129-142.
- Anderson, K.P. (2021). The relationship between inclusion, absenteeism, and disciplinary outcomes for students with disabilities. *Educational Evaluation and Policy Analysis*, 43(1) 1-28.
- Banks, J., McCoy, S., Frawley, D. (2017) One of the gang? Peer relations among students with special educational needs in Irish mainstream primary schools. *European Journal of Special Needs Education*, 33(3), 396-411
- Batu, E. S. (2000). Kaynaştırma, destek hizmetler ve kaynaştırmaya hazırlık etkinlikleri. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Özel Eğitim Dergisi*, 2(4), 35-45.
- Baydık, B., & Bakkaloğlu, H. (2009). Alt sosyoekonomik düzeydeki özel gereksinimli olan ve olmayan ilköğretim öğrencilerinin sosyometrik statülerini yordayan değişkenler. *Kuram ve Uygulamada Eğitim Bilimleri*, 9(2), 401-447.
- Black, L. I., & Zablotzky, B. (2018). Chronic school absenteeism among children with selected developmental disabilities: National health interview survey. 2014-2016 [National Health Statistics Reports. No. 118], National Center for Health Statistics.
- Bülbül, T. (2012). Yükseköğretimde okul terki: nedenler ve çözümler. *Education & Science/Eğitim ve Bilim*, 37(166), 219-235.

- Chang, Y.C., Shih, W., Landa, R., Kaiser, A., Kasari, C. (2017). Symbolic play in school-aged minimally verbal children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 48(5), 1436-1445.
- C. Vilaplana-Prieto (2011) Bullying and absenteeism among children with special needs. *INTED2011 Proceedings*, pp. 4343-4352.
- Dağ, A. (2018). Mesleki ve teknik anadolu lisesi öğrencilerinin okula uyum süreçleri hakkında nitel bir araştırma. *Uluslararası Türkçe Edebiyat Kültür Eğitim (TEKE) Dergisi*, 7(3), 1995-2012.
- Döş, İ. (2011). Ortaöğretim öğrencilerinin başarısızlık nedenlerine ilişkin öğretmen görüşleri. *Milli Eğitim Dergisi*, 41(190), 72-91.
- Eaton, D. K., Kann, L., Kinchen, S., Shanklin, S., Ross, J., Hawkins, J. (2008). Youth risk behavior surveillance united states. *Morbidity and Mortality Weekly Report*, 57(4), 1-136.
- Egalite, A.J. (2018). Peers with special educational needs and students' absences, *Educational Studies*, 1-27.
- Fleming M, Salim EE, Mackay DF, Henderson A, Kinnear D, Clark D, et al. (2020) Neurodevelopmental multimorbidity and educational outcomes of Scottish schoolchildren: A population-based record linkage cohort study. *PLoS Med* 17(10): e1003290. <https://doi.org/10.1371/journal.pmed.1003290>
- Gershenson, S. 2016. "Linking teacher quality, student attendance, and student achievement." *Education Finance and Policy* 11 (2): 125–149.
- Gershenson, S., Jackowitz, A., & Brannegan, A. (2017). Are student absences worth the worry in US primary schools? *Education Finance and Policy*, 12(2), 137–165.
- Gottfried, M. A. 2014. "Classmates with disabilities and students' noncognitive outcomes". *Educational Evaluation and Policy Analysis* 36 (1): 20–43.
- Gottfried, M. A., & Kirksey, J. J. (2017). "When" students miss school: The role of timing of absenteeism on students' test performance. *Educational Researcher*, 46(3), 119–130.
- Göl, B. (2014). *Kaynaştırma eğitimi alan görme yetersizliği olan ve gören öğrencilerin akran ilişkilerinin incelenmesi*. Yayımlanmamış Yüksek Lisans Tezi. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, 2014.
- Gökçer, N. (2012). Ortaöğretim okullarındaki devamsızlık nedenlerine ilişkin öğrenci görüşleri. *Kastamonu Eğitim Dergisi*, 20(3), 913-938.
- Gün, Z. (2013). *Ülkemizdeki kaynaştırma eğitiminin matematik eğitiminde yeri ve önemi*. Yayımlanmamış Yüksek Lisans Tezi. Fırat Üniversitesi Eğitim Bilimleri Enstitüsü, 2013.
- Güzel & Akın (2024). Okul öncesi dönemde eğitim alan özel gereksinimli çocukların eğitiminde yaşanan problemler üzerine yayımlanan araştırmaların incelenmesi. *Journal of Sustainable Education Studies*, 5(2), 70-82.
- Hoşgörür, V. & Polat, M. (2015). Ortaokul öğrencilerinin okula devamsızlık nedenleri (Söke ilçesi örneği). *Muğla Sıtkı Koçman Üniversitesi (MSKU) Eğitim Fakültesi Dergisi*, 2(1), 25-42.
- Jachova, Z., Kovacevic, J., Hasanbegovic, H. (2018). Individual Educational Plan (IEP) Foundation of Quality Inclusive Education. *Human Research in Rehabilitation the International Journal for Interdisciplinary Studies*, 8(2) 88-93.
- Kalebaşı, A. (2019). Liselerde öğrenim gören özel gereksinimli (kaynaştırma) öğrencilerin sosyal dışlanma ve yalnızlık deneyimleri üzerine nitel bir çalışma. *The Journal of Academic Social Science*, 76(76), 519-537.
- Kearney, C. A., & Graczyk, P. A. (2020). A multidimensional, multi-tiered system of supports model to promote school attendance and address school absenteeism. *Clinical child and family psychology review*, 23(3), 316-337.
- Klein, M., Sosu, E. M., & Dare, S. (2022). School absenteeism and academic achievement: does the reason for absence matter? *AERA Open*, 8. <https://doi.org/10.1177/23328584211071115>
- Koçyiğit, S. (2015). Ana sınıflarında kaynaştırma eğitimi uygulamalarına ilişkin öğretmen-rehber öğretmen ve ebeveyn görüşleri. *Uluslararası Türkçe Edebiyat Kültür Eğitim (TEKE) Dergisi*, 4(1), 391-415.
- Marlow, S. A., & Rehman, N. (2021). The relationship between family processes and school absenteeism and dropout: a meta-analysis. *The Educational and Developmental Psychologist*, 38(1), 3-23.
- Marvul, J. N. 2012. "If you build it, they will come: a successful truancy intervention program in a small high school." *Urban Education*. 47: 144–169.
- Mattson, J. G., Bottini, S. B., Buchanan, K. A., Jarbou, M., & Won, D. (2022). Examination of school absenteeism among preschool and elementary school autistic students. *Advances in Neurodevelopmental Disorders*, 6(3), 331-339.
- Mebostad, M. I., Orm, C., Orm, S., & Nordahl-Hansen, A. (2024). School refusal behaviour and social skills in children with attention-deficit/hyperactivity disorder. *International Journal of Disability, Development and Education*, 1-12.
- Melvin, M.A., Freeman, M., Ashford, L.J., Hastings, R.P., Heyne, D., Tonge, B.J., Bailey, T., Totsika, V., Gray, K.M. (2023). Types and correlates of school absenteeism among students with intellectual disability. *Journal of Intellectual Disability Research*, 67(4), 375-386.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded Sourcebook*. (2nd ed). Thousand Oaks, CA: Sage.
- Munkhaugen, E. K., Gjevik, E., Pripp, A. H., Sponheim, E., & Diseth, T. H. (2017). School refusal behaviour: Are children and adolescents with autism spectrum disorder at a higher risk?. *Research in Autism Spectrum Disorders*, 41, 31-38.
- Ochi, M., Kawabe, K., Ochi, S., Miyama, T., Horiuchi, F., & Ueno, S. I. (2020). School refusal and bullying in children with autism spectrum disorder. *Child And Adolescent Psychiatry And Mental Health*, 14, 1-7.
- Salend, S., and L. Garrick Duhaney. (1999). "The impact of inclusion on students with and without disabilities and their educators." *Remedial and Special Education* 20 (2): 114–126.
- Sevim, C., & Atasoy, R. (2020). Özel eğitim öğretmenlerinin görüşlerine göre kaynaştırma uygulamalarının değerlendirilmesi. *Milli Eğitim Dergisi*, 49(228), 215-239.

- Stiefel, L., Shiferaw, M., Ellen-Schwartz, A., Gottfried, M. (2017). Who feels included in school? examining feelings of inclusion among students with disabilities. *Educational- Researcher*, 47(2), 105-120.
- Sullivan, A. L., Van Norman, E. R., & Klingbeil, D. A. (2014). Exclusionary discipline of students with disabilities: Student and school characteristics predicting suspension. *Remedial and Special Education*, 35(4), 199–210.
- Sunera, M., Fernando, S. M., & Sunera, H. E. (2012). School refusal: behavioural and diagnostic profiles of a clinical sample. *Sri Lanka Journal of Psychiatry*, 3(1), 10–13.
- Taylı, A. (2008). Okulu bırakmanın önlenmesi ve önlemeye yönelik uygulamalar. (Edt: Çelenk, S). *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*, 8(1): 91–104.
- Teasley, M.L. (2004). Absenteeism and truancy: risk, protection and best practice implications for school social workers. *Children & Schools*, 26, 117-126.
- Teixeira De Matos, I., Morgado, J. (2016). School participation of students with autism spectrum disorders. *Journal of Research in Special Educational Needs*, 16(1), 972-977.
- Theobald, R., Goldhaber, D., Gratz, T., & Holden, K. (2017). Career and technical education, inclusion and postsecondary outcomes for students with learning disabilities. *Journal of Learning Disabilities*, 52(2) 109–119.
- Tomaskova, M., Gray, K.M., Solmi, F., Totsika, V. (2024). Exclusion and truancy of autistic adolescents in a uk population representative sample. Available at SSRN: <https://ssrn.com/abstract=4734333> or <http://dx.doi.org/10.2139/ssrn.4734333>.
- Totsika, V., Hastings, R. P., Dutton, Y., Worsley, A., Melvin, G., Gray, K., ... & Heyne, D. (2020). Types and correlates of school non-attendance in students with autism spectrum disorders. *Autism*, 24(7), 1639-1649.
- Uğraş, S. (2018). Beden eğitimi öğretmenlerinin özel gereksinimli öğrenciler hakkındaki düşünceleri. *Spor Bilimleri Alanında Yeni Ufuklar Kitabı*, 23, 365-383.
- U.S. Department of Education. (2016, June 7). *2013-2014 Civil rights data collection: A first look*. <https://www2.ed.gov/about/offices/list/ocr/docs/2013-14-first-look.pdf>.
- U.S. Department of Education. (2018b). *School climate and safety: Data highlights on school climate and safety in our nation's public schools*. <https://www2.ed.gov/about/offices/list/ocr/docs/schoolclimate-and-safety.pdf>.
- Vilaplana-Prieto C. (2011) Bullying and absenteeism among children with special needs. *INTED2011 Proceedings*, 4343-4352.
- Yıldırım, M.C ve Dönmez, B (2008). Yapılandırmacı öğrenme yaklaşımı uygulamalarının sınıf yönetimine etkileri üzerine bir çalışma. *İlköğretim Online*, 7(3): 664–679.
- Yıldırım, A. ve Şimşek, H. (2016). Sosyal Bilimlerde Nitel Araştırma Yöntemleri (Genişletilmiş 10.Baskı). Ankara: Seçkin Yayıncılık.
- Yılmaz, M., & Bayar, A. (2020). Özel eğitim sınıflarında görev yapan alan dışı öğretmenlerin yaşadığı zorluklar ve çözüm önerilerinin incelenmesi. *The Journal of Academic Social Science*, (98), 355-374.



| Research Article / Araştırma Makalesi |

Needs Analysis for Digital Literacy Course Curriculum for TÖMER Students

TÖMER Öğrencileri için Dijital Okuryazarlık Dersi Öğretim Programına Yönelik İhtiyaç Analizi

Erol MUTUĞU¹, Subhan EKŞİOĞLU², Duygu GÜR ERDOĞANI³

Keywords

1. Digital literacy
2. TÖMER
3. Curriculum Development

Anahtar Kelimeler

1. Dijital Okuryazarlık
2. TÖMER
3. Program Geliştirme

Received/Başvuru Tarihi
19.08.2024

Accepted / Kabul Tarihi
25.07.2025

Abstract

Purpose: To reveal the digital literacy skill levels and training needs of foreign students receiving Turkish education.

Design/Methodology/Approach: The digital literacy skills of the students were analysed using a mixed design in which quantitative and qualitative research methods were used together. Regarding the study group and data collection tools of the research, in the first stage, 110 students were administered the digital literacy scale, 5 trainers were interviewed through semi-structured interviews, and in the second stage, 54 foreign students were surveyed.

Findings and Results: While foreign students stated that they had digital literacy tendencies, educators stated that students had deficiencies, mistakes and errors. In the questionnaire applied to the students again, findings were found in the direction stated by the educators. As a result, it is thought that students are at an intermediate level regarding digital literacy and that a curriculum is needed in this direction to ensure their development.

Öz

Çalışmanın amacı: Türkçe eğitimi alan yabancı uyruklu öğrencilerin dijital okuryazarlık beceri düzeylerini ve eğitim ihtiyaçlarını ortaya çıkarmaktır.

Materyal ve Yöntem: Nicel ve nitel araştırma yöntemlerinin birlikte kullanıldığı karma desen kullanılarak öğrencilerin dijital okuryazarlık becerileri incelenmiştir. Araştırmanın çalışma grubu ve veri toplama araçlarıyla ilgili olarak ilk aşamada 110 öğrenciye dijital okuryazarlık ölçeği, 5 eğitime yarı yapılandırılmış görüşme ve ikinci aşamada ise 54 yabancı uyruklu öğrenciye anket uygulanmıştır.

Bulgular ve Sonuçlar: Yabancı uyruklu öğrenciler dijital okuryazarlık eğilimlerinin olduğunu belirtirken eğitimciler ise öğrencilerin eksiklerinin, yanlışlarının ve hatalarının olduğu yönde görüş belirtmişlerdir. Tekrar öğrencilere yapılan ankette eğitimcilerin belirttiği yönde bulgulara ulaşılmıştır. Sonuç olarak öğrencilerin dijital okuryazarlıkla ilgili orta düzeyde oldukları ve gelişimlerinin sağlanması için bu yönde bir öğretim programına ihtiyacın olduğu düşünülmektedir.

¹ Corresponded Author, Sakarya University, Sakarya, TÜRKİYE; <https://orcid.org/0000-0003-4447-3283>

² Sakarya University, Sakarya, TÜRKİYE; <https://orcid.org/0000-0002-5474-627X>

³ Sakarya University, Sakarya, TÜRKİYE; <https://orcid.org/0000-0002-2802-0201>

INTRODUCTION

With the introduction of technology into our daily lives, there have been changes affecting every field, and it has brought along a number of requirements depending on the innovations that have emerged. Computers, tablets, smartphones and watches have become indispensable for the basic needs of daily life. It is seen that the usability of these devices is related to the concept of literacy. However, the current equivalent of this concept is the transformation of cognitive features into skills beyond the provision of writing symbols and its use as an educational concept that enables communication by using it in an integrated manner with language (Aşıcı, 2009). The use of the concept of literacy in a broad sense has been the result of its interaction with new concepts such as writing, computer and technology. However, new literacy types such as network, scientific, digital, visual, graphic, internet, media, technology, web literacy have emerged (Önal, 2010). It is said that the content of these literacy types includes the knowledge, skills and techniques necessary for the use of technological devices, as well as initiatives to increase sociality such as communication, structuring and dissemination of information (Destebaşı, 2016).

In line with the requirements of modern life, people need to fulfill the skills of finding, producing and disseminating information through the use of technology. For this requirement, people are expected to have developed digital literacy skills. It is thought that only in this way will it be possible to sustain daily life in the digital age (Eshet-Alkalai, 2004). However, today, the concept of digital native has entered our lives for the generation that has met with technology as soon as they were born, sees all their work in digital environments with the opportunities provided by technology and has a learning language of their own (Prensky, 2001). This digital native generation needs to be trained to use the digital environment effectively, actively, meaningfully and in accordance with ethical rules (Altun & Alpan, 2021). In this context, it is predicted that the inclusion of technologies in educational environments will have positive effects on the processes and development will be achieved in schools (Karataş & Sözcü, 2013). There are projects and applications integrated into the education system of South Korea, USA, Thailand and many other countries around the world (Teo, 2011; Pamuk et al., 2013). In order to ensure this development, in Turkey, the Ministry of National Education (MoNE) activated the Opportunity Enhancement and Technology Improvement Movement (FATİH) Project in the Turkish education system in 2012 and initiated studies to increase the effectiveness of learning-teaching processes.

In addition, there is a need to have some competencies in the use of the technologies physically offered in schools. In 2018, changes were made in the education programs to affect the outcomes. In addition, in the Turkish Qualifications Framework (TQF), competencies needed in personal, social, academic and business life have been established. Digital competence, one of the eight key competencies, is said to be important (Direkçi et al., 2019). According to Özdemir (2022), digital literacy skills, namely information, media and technology skills, are expressed as follows.

1. Information literacy and its benefits are as follows;
 - Identifying the information needed
 - Identify reliable sources for accurate information
 - Legal access to resources
 - To be able to use the obtained knowledge in problem solving
2. Media literacy and its benefits are as follows;
 - Access to media messages from reliable sources
 - To be able to critically approach the messages given in the media
 - To be able to interpret the desired message in the media correctly
 - To be protected from the risky sides of the media
3. Information and communication technologies literacy and its benefits are as follows;
 - Having sufficient equipment for communication technology
 - To be able to use technological equipment in accordance with its purpose
 - To be able to comprehend that technology is a tool, not a goal, at the point of accessing and disseminating information
 - Staying within the bounds of the law

Digital literacy can be expressed as active use of technologies that fulfill their function in a way that does not pose a danger, gaining the ability to produce and collaborate through these technologies, evaluating related processes and outputs, thinking differently, approaching critically, and presenting different competencies that come together as cognitive, social and technical as a single piece (Bayrakçı & Narmanlıoğlu, 2021). In other words, it is defined as the whole of the skills of recognizing, accessing, evaluating, analyzing and synthesizing information in digital environments, producing content, sociability, sharing information and creating solution-producing unity (Elkiran & Kana, 2021). In addition, the ability to read data presented in the form of graphics, to create materials in the digital environment, and to evaluate that new information is qualified and valid is a digital literacy competency (Altun & Alpan, 2021). It is a fact that the widespread use of digital technologies, platforms and applications and their impact on the user have attracted attention (Bacalja et al. 2022). Reading, writing, watching, etc. needs made from digital screens have become indispensable for humanity (Maden & Maden, 2016, p. 1307). For the skills that emerge as a result of digital literacy, the importance of the FATİH Project in MoNE schools and the Media Literacy course being offered as an elective course are considered to be influential (Çubukçu & Bayzan, 2013). Digital literacy skills guide students to reflect personally in their social lives,

benefit their cognitive and affective learning with digital tools, and offer a set of activities in terms of trial and error, creativity, quick thinking and innovative thinking (Hobbs and Coiro; 2016).

In the study of Gür and Duman (2024), in which a systematic review of theses related to digital literacy was made, it was concluded that studies were mainly conducted in educational sciences, and it was seen that they were associated with education and examined within the scope of 21st century skills. It is stated that digital literacy skills are considered as skills that are compatible with technology today (Günüç et al., 2016). It has been revealed that digital literacy skills have gained importance in learning and teaching processes and that curricula should be created as a guiding guide for teachers in order to provide these skills to learners. It is seen that there are studies that reveal the importance and different dimensions of digital literacy skills in the literature (Eshet-Alkalai, 2004; Önal 2010; Çubukçu & Bayzan 2013; Keskin, Baştuğ, & Atmaca 2016; Gazi 2016; Yaman et al., 2016; Aruğaslan 2017; Hamutoğlu et al., 2017; Üstündağ et al., 2017; Hsu, Wenting, & Hughes 2019). Based on these studies, it is seen that there are curricula revealed in the literature, but no curriculum has been developed to support digital literacy skills for foreign students receiving Turkish language education. In the evaluations made in this context, it is thought that foreign students should be provided with digital literacy skills.

Purpose of the Research

In order to develop a curriculum, it is necessary to determine the needs through situation assessment and needs analysis (Demirel, 2007). In this direction, in the needs analysis, which is the first stage of curriculum development, it is important to determine the needs related to how education will be implemented, what students want, what information they need, what prior learning the stakeholders need before the course, and what the general needs of the education system that changes with the society are (Oliva, 2005; Karacaoğlu, 2009; Yalden, 1987; Reviere et al., 1996). In line with these needs, it was aimed to conduct a needs analysis, which is the first stage of curriculum development studies, before preparing a curriculum that supports digital literacy skills. Accordingly, answers to the following questions were sought.

1. What are the digital literacy skill levels of foreign students studying Turkish at TÖMER?
2. What are the opinions of instructors about the levels of digital literacy skills of foreign students studying Turkish at TÖMER?
3. What are the opinions of foreign students studying Turkish at TÖMER about their digital literacy skills?

METHOD

Research Model

This research was conducted according to a mixed design in which quantitative and qualitative methods were used together. Descriptive analysis approach was used as one of the approaches to identify needs analysis. The descriptive approach focuses on revealing the current situation in detail. Thus, this approach is taken as a basis for understanding the identified situation and addressing the needs (Karasar, 2004). Quantitative data were collected using the survey method. The survey method is defined as the realization of studies applied on a sample group selected from the universe in order to reach ideas that will appeal to a large-scale universe (Karasar, 2004).

Qualitative data were obtained using an explanatory case study from qualitative research methods. The explanatory case study model allows in-depth examination of a single case related to descriptive or digital literacy that aims to reveal the views of educators about the digital literacy needs of foreign students. Explanatory case study serves to explain the reasons in real life situations that are difficult and complex to investigate with experimental method (Yin, 2003, cited in Aytaçlı, 2012).

Participants

The population of the study consists of language education centers that provide Turkish education to foreign university students. The sample consists of Sakarya University of Applied Sciences Language Education and Teaching Application and Research Center (SADEM), which is the education center where the research will take place. In the selection of this sample, the convenience sampling method was preferred. This method stands out with the feature that researchers have easy access to the selected situation (Yıldırım & Şimşek, 2006). The study group in the collection of the first stage quantitative data of the research was determined by the non-randomized criterion sampling method. In this method, participants should be people who have the qualifications for the purpose of the research (Buyukozturk et al., 2021). Therefore, the first stage participants for the quantitative data consisted of 110 volunteer foreign university students with B1, B2 and C1 level Turkish proficiency criteria. The second stage participants for quantitative data consisted of 54 foreign national university students who voluntarily participated among the participants who participated in the first stage as a criterion. The participants of the qualitative data consisted of 5 educators selected by the criterion sampling method in the same way. These educators were selected as participants who met the criteria of being instructors who provided education to the participants selected for quantitative data. The sample size in qualitative research varies due to its in-depth nature (Patton, 2014, p. 244). At the point of determining the number, it means that it provides sufficient satisfaction as soon as it falls into repetition (Merriam, 2015, p.79).

In the first stage, descriptive statistics for the demographic distribution of foreign students to whom the digital literacy scale was applied are presented in Table 1.

Table 1. Demographic distribution of foreign students to whom digital literacy scale was applied

Demographic Characteristics	Group	Frequency	%
Class Level	B1	32	29.1
	B2	39	35.5
	C1	39	35.5
Gender	Female	38	34.5
	Male	72	65.5
Age	17-19	66	60.0
	Over 20 years old	44	40.0
Own PC Ownership	Yes	59	53.6
	No	51	46.4
Daily Internet Usage Time	Less than 1 hour	5	4.5
	1-2 hours	19	17.3
	3-5 hours	59	53.6
	6 hours or more	27	24.5
Do You Subscribe to Social Media?	Yes	102	92.7
	No	8	7.3

Table 1 shows the demographic characteristics of the study group of 110 foreign students receiving Turkish language education at SADEM. When the distribution of the participants on the basis of course levels is analyzed, the rate of participants at B1 level is 29.1% (32), the rate of participants at B2 level is 35.5% (39) and the rate of participants at C1 level is 35.5% (39). In terms of gender, the proportion of female participants was 34.5% (38), while the proportion of male participants was 65.5% (72). In terms of age range, 60.0% (66) of the participants were between the ages of 17-19 and 40.0% (44) were between the ages of 20 and above. When it was analyzed whether the participants had their own computers, the rate of those who answered yes was 53.6% (59), while the rate of those who answered no was 46.4% (51). On the basis of gender, the proportion of female participants was 34.5% (38), while the proportion of male participants was 65.5% (72). In terms of age range, 60.0% (66) of the participants between the ages of 17-19 and 40.0% (44) between the ages of 20 and above. When it was analyzed whether the participants had their own computers, the rate of those who answered yes was 53.6% (59), while the rate of those who answered no was 46.4% (51). Considering the duration of daily internet use, 4.5% (5) used the internet for less than 1 hour, 17.3% (19) for 1-2 hours, 53.6% (59) for 3-5 hours and 24.5% (27) for 6 hours or more. Regarding social media membership status, 92.7% (102) of the participants had a social media membership, while 7.3% (8) did not have a social media membership.

Descriptive statistics for the demographic distribution of the trainers to whom the semi-structured interview form about digital literacy was applied are presented in Table 2.

Table 2. Demographic distribution of trainers to whom digital literacy semi-structured interview form was applied

Demographic Characteristics	Group	Participants	Frequency
Gender	Male	K1, K2, K3, K4, K5	5
Working Time	2,5 years	K4	1
	3 years	K1, K2, K3	3
	10 years	K5	1

Demographic Characteristics	Group	Participants	Frequency
Graduate of Turkish Language and Literature, Faculty of Arts and Sciences	Yes	K1, K2, K3, K4, K5	5
Ownership of Technological Devices	Computer	K1, K2, K3, K4, K5	5
	Smart Watch	K3, K4	2
	Tablet PC	K5	1
Time spent on the internet per day	2-4 hours	K1, K2, K3, K4, K5	5
Are you a member of any social network?	Yes	K1, K2, K3, K4, K5	5

When Table 2 is examined, semi-structured interviews were conducted to analyze in-depth the views of educators who provide Turkish Education to foreign students on the digital literacy levels of their students. All 5 of the participants were female educators. The educators were coded as K1, K2, K3, K4 and K5. Considering their working period, K1, K2 and K3 have been teaching Turkish to foreign students for 3 years, K4 for 2.5 years and K5 for 10 years. According to the departments of the trainers, all 5 of them are graduates of the Faculty of Science and Literature, Department of Turkish Language and Literature. All of the trainers have their own computers and in addition, K3 and K4 have their own smart watches and K5 has a tablet. All of the trainers spend between 2-4 hours on the internet on a daily basis. Finally, the membership of all trainers to any social network was checked and all of them stated that they were members.

In the second stage, descriptive statistics for the demographic distribution of foreign students to whom the digital literacy questionnaire was administered are presented in Table 3.

Table 3. Demographic distribution of foreign students administered the digital literacy survey (second phase)

Demographic Characteristics	Group	Frequency	%
Gender	Male	18	33.3
	Female	36	66.7
Age	17-19	32	59.3
	20 and older	22	40.7
Have you received Digital Literacy Training?	Yes	15	27.8
	No	39	72.2
Would you describe yourself as a Professional Technology User?	Yes	24	44.4
	No	30	55.6
Which technology do you use to access information?	Computer	6	11.1
	Tablet PC	1	1.9
	Smart Phone	47	87.0
Which Technology Do You Use to Create Content?	Computer	8	14.8
	Tablet PC	2	3.7
	Smart Phone	44	81.5

Table 3 shows the characteristics of 54 foreign students. In terms of gender, 33.3% (18) of the participants were female and 66.7% (36) were male. Looking at the distribution according to age range, 59.3% (32) of the participants between the ages of 17-19 and 40.7% (22) of those aged 20 and over. When it was analyzed whether the participants had digital literacy training, it was determined that yes 27.8% (15) and no 72.2% (39). When we look at whether they are professional technology users, the rate of those who answered yes was 44.4% (24), while the rate of those who answered no was 55.6% (30). Considering the data on which technology they use more when accessing information, it was found that 11.1% (6) used computers, 1.9% (1) used tablets and 87.0% (47) used phones. Considering the data on which technology they used more while creating content, it was found that 14.8% (8) used computers, 3.7% (2) used tablets and 81.5% (47) used phones. From this point of view, it is seen that phone use is the most preferred device for finding information and creating content.

Data Collection Tools and Data Collection

In obtaining quantitative data, "Personal Information Form" was used as a data collection tool and "Digital Literacy Scale" developed by Ng (2012) and adapted into Turkish by Hamutoğlu et al. (2017) was used to determine the tendencies of foreign students towards digital literacy. The scale consists of 4 sub-dimensions covering attitude, technical, cognitive and social characteristics in 17 items in total. In order to obtain the views of foreign students on digital literacy, the "Personal Information Form" consisting of 7 items and the "Digital Literacy Questionnaire" consisting of 19 items developed by the researchers were used. The items in the questionnaire form were created by the researcher through literature reviews and data obtained from qualitative semi-structured interviews with trainers.

In order to obtain qualitative data, the "Personal Information Form", in which demographic characteristics were asked, and the "Semi-Structured Interview Form on Digital Literacy" prepared by the researchers were used. The semi-structured interview form was developed by analyzing the results of the literature review on Digital Literacy Skills. The questions were submitted to the opinions of 2 faculty members working at Sakarya University Institute of Educational Sciences, Department of Curriculum and Instruction and Department of Measurement and Evaluation. First, a measurement and evaluation expert was asked to evaluate the interview form used for qualitative research, and then experts on digital literacy were asked to review it. A description was made with the data obtained and the reader was asked to provide self-data without commenting. Finally, a confirmation review was conducted by comparing the outputs and the data obtained (Yıldırım & Şimşek, 2013). Necessary corrections were made with expert opinions, and a form was created with 8 items of personal information and 6 items of interview questions.

In the collection of quantitative data, the scale form used in the first stage of the needs analysis was shared in the chat groups of the foreign students receiving education through the managers of the language training center via Google Forms and the feedback was completed within 1 week. During the same period, semi-structured interviews were conducted with the trainers simultaneously and qualitative data were collected by voice recording method. The questionnaire form used in the second stage was reproduced by printing method and the application was carried out by presenting it to the students in person at the language training center. During the interviews, the researcher avoided giving directions to the participants in cases where the questions were not understood and made additional explanations. The interviews with the trainers of the foreign students lasted approximately 10-20 minutes. The confidentiality and privacy of the participants were protected and personal information about their private lives such as name and surname were not collected. The data obtained after the interviews were shared with the participants and the relevant statements were confirmed.

Data Analysis

The data collected in the study were analyzed in line with the data obtained from the study groups. Step calculation was made to determine the levels according to the scores obtained from the scale and the interpretation according to which value ranges will be made is shown in Table 4.

Table 4. Interpretation of the mean obtained from the digital literacy scale

Mean/Number of Articles	Value	Decision
1.00 – 1.79	1	Very Low Level
1.80 – 2.59	2	Low Level
2.60 – 3.39	3	Middle Level
3.40 – 4.19	4	High Level
4.20 – 5.00	5	Very High Level

Table 4 shows that values between 1 and 1.79 can be interpreted as very low level and values above 4.20 as very high level. Content analysis was used to analyze qualitative data. In the use of content analysis, it is aimed to group the data in a conceptually related way. The data obtained must first be conceptualized and then organized and thematized to form a meaningful whole (Yıldırım & Şimşek, 2013). With the semi-structured interviews conducted by the researcher in order to determine the details by conducting an in-depth examination based on the opinions of the educators, the opinions about the students' levels of digital literacy were tried to be revealed through coding and themes.

Descriptive analysis was used to analyze the questions in the questionnaire form used to obtain the opinions of foreign students. The answers given by foreign students to each question were analyzed with percentage-frequency analysis, and their opinions on the relevant question were obtained and contributed to the needs analysis related to the curriculum.

Limitations of the Research

1. The effectiveness and efficiency studies to be used in developing a curriculum that supports digital literacy skills in teaching Turkish as a foreign language are limited to foreign students studying at Sakarya University of Applied Sciences Language Teaching Center in the fall semester of 2023-2024 academic year.
2. The quantitative findings obtained in the study are limited to the foreign students who received education at the B1, B2 and C1 course level at the Sakarya University of Applied Sciences Language Teaching Center in the 2023-2024 Academic Year Fall Semester and participated in the research.
3. The qualitative findings obtained in the study are limited to the data obtained as a result of the interviews with the educators who provided the training.

FINDINGS

A-Quantitative Findings of the Scale

The analysis of the data collected in the study was evaluated in line with the data obtained from the study groups. In deciding which methods to use for the analysis of quantitative data, normality test was performed by looking at kurtosis and skewness values. The relevant result is presented in Table 5.

Table 5. Normality test results for the digital literacy scale and its subscales

	Digital Literacy Scale	Attitude	Technical	Cognitive	Social
n	110	110	110	110	110
Kolmogorov-Smirnov	.108	.135	.154	.198	.168
P	.003	.000	.000	.000	.000
Skewness	-1.012	-1.129	-.933	-.876	-.655
Kurtosis	1.603	1.564	1.371	.417	.441

As a result of the normality tests, it is seen in Table 5 that the scale and its sub-dimensions do not meet the normal distribution ($p < .05$) in the Kolmogorov-Smirnov test results. However, normal distribution was not decided only with this data, but also by examining the skewness and kurtosis values. From this point of view, it can be said that the skewness and kurtosis values show normal distribution since they are between -2 and +2 (George, & Mallery, 2010). For the reliability analysis, while the Cronbach Alpha value of the scale itself was .93, the Cronbach Alpha value in this study was found to be .954. Therefore, it can be said that the reliability of the scale on our sample is at a high level.

The descriptive values related to the total scores obtained from the sub-dimensions of the Digital Literacy Scale (Attitude, Technical, Cognitive and Social) and the whole scale of foreign students receiving Turkish education are presented in Table 6.

Table 6. Total mean score values of the DLS and its sub-dimensions

	Digital Literacy Scale	Attitude	Technical	Cognitive	Social
Total Score Average	3.6519	3.6584	3.6924	3.6409	3.5182
Evaluation	High Level	High Level	High Level	High Level	High Level

When Table 6 is examined, it can be said that the total score and the scores of the sub-dimensions are between 3.40 - 4.19, so it can be said that they are highly digitally literate. When similar studies are examined, it can be concluded that the total scores of the digital literacy scale of university students are at high and partially high levels and that they have tendencies towards digital literacy skills (Kozan & Bulut Özek, 2019; Boyacı, 2019; Göldağ & Kanat, 2018; Şahin, 2021; Çolak & Öztürk, 2022; Bay, 2021).

B-Qualitative Findings

Semi-structured interviews were conducted with educators about the level of digital literacy skills of foreign students. It was found that the trainers explained their views under the themes of digital platforms, access to information, verifying information, ethics, security, learning to learn, production and sharing. The related codes belonging to the themes created in this direction are given in Table 7.

Table 7. Theme, Code, Frequency and Percentage Table for Semi-structured Interviews

Themes	Participant No	Codes	Frequency	%
Digital Platforms	K1, K2	Ability to use	2	28.5
	K3, K5, K2	Using Effectively	3	42.9
	K5	High Level Use	1	14.3

Themes	Participant No	Codes	Frequency	%
Access to Information	K5	Commitment to Practice	1	14.3
	K1, K2	How to Search Information	2	50.0
	K4	Using Initial Knowledge	1	25.0
Validating Information	K5	Lack of Time	1	25.0
	K1	Negative Technology Impact	1	33.3
	K4	No Verification	1	33.3
Ethics	K5	Ability to Select the Suitable Platform	1	33.3
	K1, K3, K4	Digital Citizenship	3	60.0
	K4, K5	Fake Account Usage	2	40.0
Safety	K1	Inadequacy of Security Information	1	25.0
	K4	Communicating with Strangers	1	25.0
	K3	Not Using Strong Password	1	25.0
Production and Sharing	K5	Failure to take precautions against fraud	1	25.0
	K2	Producing and Sharing Presentations	1	33.3
	K2	Creating and Sharing Images	1	33.3
Learning to Learn	K3	Content Creation and Sharing	1	33.3
	K2	Incentivising	1	50.0
	K4	Encouragement	1	50.0

When Table 7 is examined, according to the opinions of the trainers participating in the research on the needs of foreign students regarding digital literacy;

- Under the theme of Digital Platforms, it is seen that the code of being able to use it is 28.5%, the code of being able to use it effectively is 42.9%, the code of being able to use it at a high level is 14.3% and the code of commitment to the application is 14.3%. According to the opinions of the trainers, it is revealed that the majority of foreign students have inadequacies in using digital platforms.
- Under the theme of Access to Information, it is seen that the code of how to search is 50.0%, the code of using the first information is 25.0% and the code of not having time is 25.0%. From this point of view, it can be said that foreign students have inadequacies in how to search for information, using the first information they reach and accessing information from social media and games.
- Under the theme of verifying information, the codes of negative technology effect, not verifying and choosing the appropriate platform have equal rates and are 33.3%. Thus, it can be said that students have inadequacy in these code headings at the point of verifying the information they access.
- Under the theme of ethics, it was found that the digital citizenship code had a rate of 60.0% and the code for using fake accounts had a rate of 40.0%. From this point of view, it can be said that foreign students have inadequacies in respect, following the rules, and building digital identity within the framework of digital citizenship.
- Under the security theme, the codes of insufficient security knowledge, communicating with unfamiliar people, not using strong passwords and not taking precautions against fraud have equal rates and are seen as 25.0%. When these codes are considered together, it can be said that foreign students do not have sufficient knowledge about security problems in digital environments.
- Under the theme of production and sharing, it is seen that the codes of presentation, visual and content production and sharing have equal rates of 33.3%. From this point of view, it can be said that foreign students are weak in producing skills in digital environments.
- It can be seen that the codes of encouraging and encouraging under the theme of learning to learn are equal with a rate of 50.0%. From this point of view, it can be said that students need motivational guidance to be encouraged and encouraged to provide learning by using digital platforms.

C-Quantitative Findings of the Questionnaire

Descriptive values of foreign students' views on digital literacy skills are presented in Table 8.

Table 8. Frequency and Percentage Table of Digital Literacy Questionnaire Items

Items	Strongly Disagree		Disagree		Undecided		Agree		Strongly Agree	
	f	%	f	%	f	%	f	%	f	%
1. I find it difficult to understand digital platforms when I use them for the first time.	6	11.1	16	29.6	20	37.0	12	22.2	0	0

Items	Strongly Disagree		Disagree		Undecided		Agree		Strongly Agree	
	f	%	f	%	f	%	f	%	f	%
2. I use digital platforms limitedly except for my basic communication needs.	4	7.4	15	27.8	14	25.9	19	35.2	2	3.7
3. I have no difficulty in accessing, filtering and searching information in search engines.	4	7.4	10	18.5	14	25.9	19	35.2	7	13.0
4. I act consciously about security and ethical issues when using digital media.	0	0	6	11.1	16	29.6	23	42.6	9	16.7
5. I act consciously about security and ethical issues when using digital media.	3	5.6	2	3.7	12	22.2	30	55.6	7	13.0
6. I have high skills in producing and sharing content on digital platforms (canva, adobe express, hootsuite, etc.).	1	1.9	12	22.2	21	38.9	17	31.5	3	5.6
7. I effectively use office programmes such as slides, word, excel and creating visual materials.	1	1.9	11	20.4	14	25.9	21	38.9	7	13.0
8. I use social media tools for many different purposes besides making friends.	1	1.9	6	11.1	12	22.2	25	46.3	10	18.5
9. I can easily use mobile applications in different languages.	3	5.6	7	13.0	15	27.8	25	46.3	4	7.4
10. I can easily learn on my own in digital environments.	0	0	6	11.1	16	29.6	28	51.9	4	7.4
11. My skills in interacting with visual and digital materials are weak.	1	1.9	22	40.7	23	42.6	8	14.8	0	0
12. I know what to do consciously against cyberbullying on digital platforms.	1	1.9	6	11.1	22	40.7	22	40.7	3	5.6
13. I have knowledge about cyber security, broadcast theft, etc.	4	7.4	12	22.2	16	29.6	19	35.2	3	5.6
14. My skills for security measures in digital environments are good.	5	9.3	10	18.5	15	27.8	23	42.6	1	1.9
15. Individually, I have good technical and productive skills in digital environments.	2	3.7	9	16.7	18	33.3	22	40.7	3	5.6
16. I need guidance to participate effectively in digital environments.	0	0	11	20.4	26	48.1	14	25.9	3	5.6
17. I have no difficulty in using digital platforms to access and verify information.	2	3.7	7	13.0	18	33.3	23	42.6	4	7.4
18. I make effective use of open access resources and learning platforms in digital environments.	3	5.6	3	5.6	22	40.7	23	42.6	3	5.6
19. I use future technologies (artificial intelligence, internet of things, machine learning, etc.) at a good level.	1	1.9	8	14.8	18	33.3	22	40.7	5	9.3

When Table 8 is analysed, it is seen that the prominent items are items 1, 2 and 16 in line with the answers given by 54 students participating in the survey. According to the 1st item "I have difficulty in understanding digital platforms when I use them for the first time.", 20 (37%) of the foreign students were undecided and 12 (22.2%) of them agreed. According to the 2nd item "I use digital platforms limitedly except for my basic communication needs.", 14 (25.9%) of the foreign students were undecided, 19 (35.2%) agreed and 2 (3.7%) strongly agreed. When we look at the 16th item "I need guidance to participate effectively in digital environments", 26 (48.1%) of the foreign students were undecided, 14 (25.9%) agreed and 3 (5.6%) strongly agreed. From this point of view, it is concluded that foreign students need to improve their skills of first use of digital platforms and active participation in digital literacy skills. In questions 6, 11, 12, 15, 17, 18 and 19, it is seen that foreign students have a tendency towards digital literacy skills in line with their opinions, but one third and more of the participants answered these questions as undecided. When these questions are examined in detail, it is determined that there are skills of content production and sharing in question 6, interaction with visual and digital materials in question 11, being aware of cyberbullying in question 12, technical and productivity in question 15, verifying information in question 17, learning to learn in question 18 and using future technologies in question 19. From this point of view, it is seen that foreign students have needs to increase their digital literacy levels on the basis of these skills.

DISCUSSION AND CONCLUSION

In this study, which was conducted to determine the training needs of foreign students related to digital literacy skills, the Digital Literacy Scale was first applied to determine the students' tendencies towards digital literacy, and as a result, the total score of the scale and the separate scores of the sub-dimensions were calculated and determined. From this point of view, we can say that foreign students who participated in the first stage of the needs analysis have a high level of tendencies towards digital literacy. Similarly, Çolak and Öztürk (2022) examined the digital citizenship levels of pre-service social studies teachers, Bay (2021) examined the digital literacy levels of preschool, Şahin (2021) examined religious culture and ethics, Kozan and Bulut Özek (2019) examined the digital literacy levels of Computer and Instructional Technology Education (CITE) department, Boyacı (2019) examined the digital literacy levels of pre-service teachers, and Göldağ and Kanat (2018) examined the digital literacy levels of students studying fine arts. In these studies, it is seen that similar results were reached in line with the views of the participants.

The themes of digital platforms, access to information, verifying information, ethics, security, learning to learn, production and sharing were the topics obtained through content analysis from semi-structured interviews with the instructors in the institutions where foreign students receive education. In the studies of Paul Glistler (1997) and Holum and Gahala (2001), who were pioneers in the emergence of the concept of digital literacy, the definitions of creating content through digital platforms, accelerating learning and making sense of content support some of the themes that emerged in this study. In addition, in another definition of digital literacy that supports this study, it is stated that content should be produced and shared by having some competencies such as accepting and accessing digital resources, organizing and evaluating the content, completing and integrating the analysis processes (Martin, 2005). These themes obtained from qualitative data can be the titles that will form the framework of objectives/outcomes, contents, educational situations and testing situations as the educational need for a digital literacy curriculum that can be prepared for foreign students, as can be seen in the digital literacy skills activity book prepared by the General Directorate of Secondary Education (2023). In addition, it also determined the items of the questionnaire form to be used in determining the educational needs of the students.

In the case study, which was carried out concurrently with the process of determining the tendencies of the students in the needs analysis, a questionnaire form was created to determine the views of foreign students on digital literacy skills after semi-structured interviews. In line with this survey, it was determined that almost three quarters of the participant students did not receive digital literacy training and more than half of them were not professional technology users. As stated in Gültekin and Özel's (2024) study, mastery of digital environments does not only mean access, but also the use of the technology at an expert level and equipped. In the study conducted on the digital literacy levels of classroom teachers (Korkmaz, 2020), it was concluded that the digital literacy levels of classroom teachers who received technology training from both an in-service course at the Ministry of National Education and a private course were at a higher level than those who did not, which shows that there is a need for a training program in this direction. From this point of view, it supports the conclusion that the digital literacy levels of foreign students should be increased. However, it has been concluded that students use their phones to access information and create content at a high rate. Churchill (2020) states in his study that students use mobile tools with the skills of research, data collection, analysis and reproduction. It is stated that students use mobile tools to access information suddenly, to think about and develop information, and to share it. Thus, it supports this study in the sense that they mainly solve problems with the use of mobile tools in developing access to information and content creation from digital literacy skills.

When we look at the findings obtained from the questionnaire items, it can be concluded that the skills related to digital platforms should be developed since more than half of the students responded as undecided and agree according to their answer to the question "I have difficulty in understanding digital platforms when I use them for the first time", and the students responded as undecided, agree and strongly agree at high rates according to their answer to the question "I use digital platforms limitedly except for my basic communication needs". Korkmaz (2020) stated that there is a difference between classroom teachers using only one of the smart board, projector or EBA application and using all these tools in an integrated way. In addition, Doyle-Jones (2015, pp. 114-115) emphasized that classroom teachers' use of applications such as Moodle and Edmodo integrated with technological tools such as Dropbox, Puppet Pals, Clickers, Kidsblog, Google Docs, Padlet and Timetoast increased their digital literacy levels. These studies support the importance of active and effective use of digital platforms. It can be concluded that digital literacy trainings should be planned for the reason that the students predominantly answered "agree" to the question "I need guidance for effective participation in digital environments". Lee (2014), who supports this result, states that there is an increase in the average level of digital literacy based on the comparison between the pre-test and post-test and the reason for this is the training provided. In addition, Altun (2024) states that digital literacy education should be developed in a broad scope starting from primary education to students in higher education, and Perdana et al. (2019) states that a learning model should be developed. Kul (2020) emphasized that digital literacy levels should be increased in order to prevent technology addiction, which will be realized by implementing trainings in line with professionally planned training programs.

In line with the findings obtained from items 6, 11, 12, 15, 17, 18 and 19, foreign students were undecided about their skills such as content production and sharing, interaction with visual and digital materials, being aware of cyberbullying, technique and productivity, verifying information, learning to learn and using future technologies. Ervianti et al. (2023) states that students should be actively used to develop their digital literacy skills in the learning process, and that learning is meaningful if the content is produced, edited, reused, shared and controlled. Thus, this study supports the need for foreign students who do not receive

digital literacy education to acquire the skills they are undecided about. Lazonder et al. (2020), on the other hand, state that in the growth process of students, the most developed digital literacy skills are the ability to collect information from the internet and the least developed is the ability to create content. As a result of the interviews with the trainers, it is concluded that the digital platforms, access to information, information verification, ethics, security, learning to learn, production and sharing themes obtained in relation to the needs of foreign students for digital literacy skills are in line with the themes.

As a result, considering the tendencies of the students, the opinions of the trainers and the levels of the survey results, it is thought that the students are at an intermediate level regarding digital literacy and there is a need to design, develop, implement and test the effectiveness of a curriculum in this direction.

Due to the increasing need for digital literacy skills today, research has been conducted in many sample groups. In this study, research was conducted on foreign university students. In this direction, it is recommended that this research be carried out in different samples, which are lacking in the literature, which is considered important in this direction. In addition, depending on the results of this research, it is recommended that the processes of designing, developing, implementing and testing the effectiveness of the curriculum that emerges as a need should be carried out. In addition, it is recommended to conduct long-term follow-up research to see the reflections of the curriculum to be developed for the education to be offered to the students on the skills of the students.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

Funding

The authors received no financial support for the research, author-ship, and publication of this article.

Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Authors' declarations of contribution

Mutugu, E. and Gür Erdoğan, D. designed the study. Mutugu, E. and Ekşioğlu, S. developed the theory and performed the calculations. Mutugu, E. and Gür Erdoğan, D. created the methodological parts and planned the execution of the process. Eksioğlu, S. encouraged Mutugu, E. in the research and supervised the findings of this study. All authors discussed the results and contributed to the final manuscript.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

This study was approved with the decision numbered "03" taken at the meeting of Sakarya University Educational Research and Publication Ethics Committee dated 22.11.2023 and numbered 25.

REFERENCES

- Altun, N., & Alpan, G. B. (2021). Digital literacy in basic education programmes. *Journal of Education and Society Research*, 8(2), 280-294. <http://dx.doi.org/10.7575/aiac.ijels.v.10n.4p.27>
- Altun, O. (2024). *Examination of the digital literacy status of adolescents in high school level education in terms of providing cyber security: Kırıkkale province sample* [Unpublished Master Thesis]. Kırıkkale University.
- Arugaslan, E., (2017). Digital Literacy of Adults. *Paper presented at the European Electronic Platform for Adult Learning New Skills in Adult Education Conference (2-3 November 2017)*. Isparta: Suleyman Demirel University.
- Asıcı, M. (2009). Literacy as a Personal and Social Value. *Journal of Values Education*, 7(17), 9-26.
- Aytaçlı, B. (2012). A Detailed Analysis on Case Study. *Adnan Menderes University Faculty of Education Journal of Educational Sciences*, 3(1), 1-9.
- Bacalja, A., Beavis, C., & O'Brien, A. (2022). Shifting landscapes of digital literacy. *The Australian Journal of Language and Literacy*, 45(2), 253–263. doi.org/10.1007/s44020-022-00019-x

- Bay, D. N. (2021). Digital Literacy Levels of Preschool Teacher Candidates. *Mustafa Kemal University Journal of Faculty of Education*, 5(7), 172-187. <https://doi.org/10.31681/jetol.1034697>
- Bayrakçı, S., & Narmanlıoğlu, H. (2021). Investigation of Digital Literacy Levels of Undergraduate Students and Graduates in Turkey. *AJIT-e: Online Academic Journal of Information Technology*, 12(46), 46-67. <https://doi.org/10.5824/ajite.2021.03.003.x>
- Boyaç, Z. (2019). *The relationship between lifelong learning tendencies and digital literacy levels of pre-service teachers (A Düzce University sample)*. [Unpublished Master Thesis]. Sakarya University.
- Büyüköztürk, Ş., Kılıç-Çakmak, E., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2021). *Scientific research methods*. Pegem.
- Churchill, N. (2020). Developing students' digital literacy skills through digital storytelling with mobile devices. *Education Media International*, 57 (3), 271-284. <https://doi.org/10.1080/09523987.2020.1833680>
- Cohen, L., Manion, L. & Morrison, K. (2007). *Research methods in education* (6th ed.). Routledge.
- Colak, A. & Ozturk, T. (2022). Investigation of Social Studies Teacher Candidates' Digital Citizenship Levels in Terms of Various Variables. *International Journal of New Approaches in Social Sciences*, 6(2), 367-394. <https://doi.org/10.38015/sbyy.1208473>
- Cubukcu, A. & Bayzan, S. (2013). Digital Citizenship Perception in Turkey and Methods to Increase This Perception through Conscious, Safe and Effective Use of the Internet. *Middle Eastern & African Journal of Educational Research*, 5, 148-174.
- Demirel, O. (2007). *Curriculum development in education* (10th ed.). Pegem A Publishing.
- Destebasi, F. (2016). New literacies: definition, scope, and theoretical underpinnings. *Turkish Studies, International Periodical for the Languages, Literature and History of Turkish or Turkic*, 895-910. <http://dx.doi.org/10.7827/TurkishStudies.9398>
- Direkci, B., Akbulut, S., & Simsek, B. (2019). The Analysis of Turkish Course Curriculum (2018) and Secondary School Turkish Textbooks in Terms of Digital Literacy Skills. *International Journal of Euroasian Researches*, 7 (16), 797-813. <https://doi.org/10.33692/avasyad.543868>
- Doyle-Jones, S. C. (2015). *Importance of working collaboratively and risk-taking with digital technologies when teaching literacy* [Doctoral Thesis, University of Toronto]. <https://utoronto.scholaris.ca/server/api/core/bitstreams/ee429385-fd26-4857-911e-c34ebde06387/content>.
- Duran, E., & Özen, N. E. (2018). Digital literacy in Turkish lessons. *Turkish Journal of Education*, 3(2), 31-46.
- Ervianti, E., Sample, R. & Pratama, MP (2023). The impact of digital literacy on student learning. *Classic: Journal of Education, Language Teaching and Science*, 5 (2), 358-365. <https://doi.org/10.52208/klasikal.v5i2.878>
- Kana, F., & Elkıran, Y. M., (2021). Teaching Turkish as a foreign language language policy-culture-methodology-technology. D. Köksal, Ö. G. Ulum and E. Duruk (Ed.), *Digital Literacy, Distance Education and Material Development in Teaching Turkish as a Foreign Language* (pp.71-89). Nobel Academic Publishing.
- Eshet-Alkalai, Y. (2004). Digital literacy: A conceptual framework for survival skills in the digital era. *Journal of Educational Multimedia and Hypermedia*, 13 (1), 93-106.
- George, D., & Mallery, M. (2010). *SPSS for Windows Step by Step: A Simple Guide and Reference, 17.0 update* (10a ed.). Pearson.
- Gilster, P. (1997). *Digital literacy*. John Wiley.
- Göldag, B., & Kanat, S. (2018). Digital literacy status of fine arts education students. *The Journal of Academic Social Science Studies*, 70, 77-92. <http://dx.doi.org/10.9761/JASSS7736>
- Gültekin, V., & Özel, N. (2024). Digital literacy skills of university students. *Journal of Ankara University, Faculty of Language and History-Geography*, 64(1), 384-420. doi.org/10.33171/dtcjournal.2024.64.1.16
- Günüç, S., Odabaşı, H., & Kuzu, A. (2013). The Defining Characteristics of Students of The 21st Century By Student Teachers: A Twitter Activity. *Theory and Practice in Education*, 9(4), 436-455.
- Gür, Z. B., & Duman, S. N. (2024). Systematic review of theses on digital literacy. *National Journal of Education Academy*, 8(1), 126-137. <https://doi.org/10.32960/uead.1434912>

- Hamutoglu, N. B., Gungoren, O. C., Uyanik, G. K., & Erdogan, D. G. (2017). Adapting digital literacy scale into Turkish. *Ege Journal of Education*, 18(1), 408-429. <https://doi.org/10.12984/egeefd.295306>
- Hobbs, R. & Coiro, J. (2016). Everyone learns from everyone. *Journal of Adolescent and Adult Literacy*, 59(6), 623-629. <http://dx.doi.org/10.1002/jaal.502>
- Hsu, H. P., Wenting, Z., & Hughes, J. E. (2019). Developing Elementary Students' Digital Literacy Through Augmented Reality Creation: Insights From a Longitudinal Analysis of Questionnaires, Interviews, and Projects. *Journal of Educational Computing Research*, 57(6), 1400-1435. <http://dx.doi.org/10.1177/0735633118794515>
- Lazonder, A. W., Walraven, A., Gijlers, H., & Janssen, N. (2020). Longitudinal assessment of digital literacy in children: Findings from a large Dutch single-school study. *Computers & education*, 143, Article 103681. <doi.org/10.1016/j.compedu.2019.103681>
- Lee, S. H. (2014). Digital literacy education for the development of digital literacy. *International Journal of Digital Literacy and Digital Competence (IJDLDC)*, 5(3), 29-43. <http://dx.doi.org/10.4018/ijdlc.2014070103>
- Karasar, N. (2004). *Scientific Research Method*. Nobel Academy.
- Karataş, I. H., & Sozcu, O. F. (2013). Awareness, attitudes and expectations of school administrators concerning FATİH project: a situation analysis. *Electronic Journal of Social Sciences*, 12(47), 41-62.
- Keskin, H. K., Bastug, M., & Atmaca, T. (2016). Factors Directing Students to Academic Digital Reading. *Education and Science*, 41(188). <http://dx.doi.org/10.15390/EB.2016.6655>
- Korkmaz, M. (2020). *Determination of digital literacy levels of classroom teachers* [Unpublished Master Thesis]. Eskişehir Osmangazi University.
- Kozan, M., & Bulut Özek, M. (2019). Investigation of Digital Literacy Levels and Sensitivity to Cyberbullying of Pre-service Teachers of ITET Department. *Firat University Journal of Social Sciences*, 29(1), 107-120. <https://doi.org/10.18069/firatsbed.538657>
- Kul, S. (2020). The investigation of the relationship of internet addiction with digital literacy and various other variables. *International Journal of Management Information Systems and Computer Science*, 4(1), 28-41. <doi.org/10.33461/uybisbbd.646682>
- Ng, W. (2012). Can we teach digital natives digital literacy? *Computers & Education*, 59, 1065-1078. <https://doi.org/10.1016/j.compedu.2012.04.016>
- Oliva, P.F. (2005). *Developing the curriculum*. (6th ed.). Pearson.
- Karacaoglu, O. C. (2009). Needs Analysis and The Delphi Technique: Case of Determination of Teachers' Educational Needs. *I. International Congress of Education Research, May 2009*. Canakkale.
- Maden, S. & Maden, A. (2016). Attitudes of secondary school students towards screen reading. *International Journal of Turkish Literature Culture Education*, 5(3), 1305-1309.
- Martin, A. (2005). DigEuLit — a European framework for digital literacy: A progress report. *Journal of e-Literacy*, 2(2), 130-136.
- MEB General Directorate of Secondary Education (2023). Digital Literacy Skills Activity Book. Retrieved April 2, 2025 from <https://ogmmateryal.eba.gov.tr/kitap/okuryazarlik-becerileri/dijital-okuryazarlik/dijital-okuryazarlik.pdf>
- Merriam, S. B. (2015). *A guide to qualitative research design and implementation* (S. Turan, Trans.). Nobel Publications (2009)
- Onal, I. (2010). Lifelong Learning and Literacy in Process of Historical Change: A Turkish Experience. *Information World*, 11(1), 101-121. <http://dx.doi.org/10.15612/BD.2010.258>
- Ozdemir, U. (2022). *The correlation between lifelong tendencies and 21st century skills self efficacy perception of secondary school teachers*. [Unpublished Master Thesis]. Sakarya University.

- Pamuk, S., Cakir, R., Ergun, M., Yilmaz, H. & Ayas, C. (2013). The use of tablet pc and interactive board from the perspectives of teachers and students: Evaluation of the FATİH project. *Educational Sciences in Theory and Practice*, 13 (3), 1799-1822. <http://dx.doi.org/10.12738/estp.2013.3.1734>
- Patton, M. Q. (2014). *Qualitative research and evaluation methods* (1st Edition). (M. Bütün, S. B. Demir, Trans.). Pegem Academy (2001).
- Perdana, R., Yani, R., Jumadi, J. & Rosana, D. (2019). Assessment of digital literacy skills of students in Yogyakarta high school. *JPI (Indonesian Journal of Education)*, 8(2), 169-177. <http://dx.doi.org/10.23887/jpi-undiksha.v8i2.17168>
- Prensky, M. (2001). Digital natives, digital immigrants Part – 1. *On the Horizon*, 9(5), 1-6. <http://dx.doi.org/10.1108/10748120110424816>
- Reviere, R., Berkowitz, S., Carter, C.C., & Ferguson, C.G. (1996). *Needs assessment: A creative and practical guide for social scientists*. Taylor & Francis. <https://doi.org/10.4324/9781315800769>
- Şahin, A. (2021). The Examination of Digital Literacy Levels and Attitudes towards E-Learning of Religious Culture and Moral Knowledge Pre-service Teachers. *Journal of the Human and Social Science Researches*, 10(4), 3496-3525. <https://doi.org/10.15869/itobiad.937532>
- Teo, T. (2011). Technology Acceptance Research in Education. T. Teo (Ed.). *Technology Acceptance in Education: Research and Issues* (pp. 1-5). Sense Publishers.
- Üstündag, M. T., Günes, E. & Bahcivan, E. (2017). Turkish Adaptation of Digital Literacy Scale and Investigating Pre-service Science Teachers' Digital Literacy, *Journal of Education and Future*, 12, 19-29.
- Yalden, J. (1987). *Principles of Course Design for Language Teaching*. Cambridge University Press.
- Yaman, F., Donmez, O., Avci, E., & Kabakci Yurdakul, I. (2016). Integrating Mobile Applications into Hearing Impaired Children's Literacy Instuction. *Education and Science*, 41(188), 153-174. <http://dx.doi.org/10.15390/EB.2016.6687>
- Yıldırım, A., & Simsek, H. (2006). *Qualitative research methods in social sciences*. (6th ed.). Seçkin Publishing.
- Yıldırım, A., & Simsek, H. (2013). *Qualitative research methods in social sciences*. Seçkin Publishing.



| Research Article / Araştırma Makalesi |

AN INVESTIGATION OF THE *YENİ HESÂB* (NEW CALCULUS) AND *YENİ HENDESE* (NEW GEOMETRY) TEXTBOOKS OF KIRKOR KÖMÜRCİYAN, ONE OF THE LATEST OTTOMAN MATHEMATICIANS, IN THE CONTEXT OF ASSOCIATION SKILLS

SON DÖNEM OSMANLI MATEMATİKÇİLERİNDEN KIRKOR KÖMÜRCİYAN'IN *YENİ HESÂB* VE *YENİ HENDESE* DERS KİTAPLARININ İLİŞKİLİNDİRME BECERİSİ BAĞLAMINDA İNCELENMESİ

Tuğba ÇAY¹, Lütfi İNCİKABI², Müjdat TAKICAK³

Keywords

1. Ottoman Mathematics Education
2. Mathematics Education in the Early Years of the Republic of Türkiye
3. Kirkor Kömürçiyân
4. Association Skills

Anahtar Kelimeler

1. Osmanlı Matematik Eğitimi
2. Türkiye Cumhuriyeti'nin İlk Yıllarında Matematik Eğitimi
3. Kirkor Kömürçiyân
4. İlişkilendirme Becerileri

Received/Başvuru Tarihi
30.12.2024

Accepted / Kabul Tarihi
25.07.2025

Abstract

In this study the transliteration of two books named Yeni Hesâb and Yeni Hendese, written by Kirkor Kömürçiyân, one of the successful late Ottoman mathematicians, was made by the researcher with expert support and the association skills in the book content were examined. The data of the study was created by document analysis, one of the qualitative research methods. While examining mathematical association skills, four main headings within the concept framework created by Bingölbali and Coşkun (2016) were used. Each activity in the textbooks are categorized and divided into classes by a mathematics expert within the framework of these four main headings. After all classification processes, frequency tables of the activities were created, and the findings were prepared. As a result of the study, findings regarding the ability to make positive associations were found in both books Yeni Hesâb and Yeni Hendese, although they were written in 1925. In the context of different representations, it was found that the most relationships were seen in both books, and the interdisciplinary relationships were the least. While the most relationship was seen between different representations of the concept, it was found that the relationship between disciplines was the least. Associations with real life have been used to a considerable extent both in examples and exercises, as well as in lectures and activities.

Öz

Bu çalışmada son dönem Osmanlı matematikçilerinden Kirkor Kömürçiyân'a ait Yeni Hesâb ve Yeni Hendese isimli iki kitabın transliterasyonu araştırmacı tarafından uzman desteği ile yapılmış ve kitap içeriklerinde yer alan ilişkilendirme becerileri incelenmiştir. Nitel araştırma yöntemlerinden doküman analizi ile çalışmanın verileri oluşturulmuştur. Matematik ilişkilendirme becerileri incelenirken Bingölbali ve Coşkun (2016)'un oluşturduğu kavram çerçevesinde yer alan dört ana başlıktan yararlanılmıştır. Ders kitaplarında yer alan her bir etkinlik bu dört ana başlık çerçevesinde, kategorilendirilmiş ve sınıflara ayrılmıştır. Tüm sınıflandırma işlemlerinden sonra etkinliklerin frekans tabloları oluşturulmuş ve bulgular hazırlanmıştır. Yapılan çalışma sonucunda 1925 yıllarında yazılmış olmasına rağmen Yeni Hesâb ve Yeni Hendese kitaplarının her ikisinde de olumlu anlamda ilişkilendirme becerisine dair bulgulara ulaşılmıştır. En fazla ilişki; kavramın farklı gösterimleri arasında görülürken, disiplinler arası ilişkinin ise en az bulunduğu rastlanmıştır. Örnek ve alıştırılarda kavramlar arası ilişkilendirmelere daha fazla rastlanırken, farklı gösterimler arası ilişkilendirmeler daha az rastlanan kategori olmuştur. Gerçek yaşam ile ilişkilendirme ise hem örnek ve alıştırılarda hem de konu anlatım ve etkinliklerde kayda değer miktarda kullanılmıştır.

¹ Kastamonu University, Kastamonu, Türkiye; <https://orcid.org/0009-0008-8352-5203>

² Corresponded Author, Mathematics and Science Education Departmet, Kastamonu University, Kastamonu, Türkiye; <https://orcid.org/0000-0002-7912-780X>

³ Philosophy Department, Kastamonu, Türkiye; <https://orcid.org/0000-0002-7809-5156>

INTRODUCTION

History is the branch of science that investigates all the practices of human communities, the developments they have experienced and the events that have occurred between them with documents in the relationship of cause and effect by showing place and time and transferring them to the present (Özçelik, 1993). It has been observed that the history of education has always influenced the progress of a society. Education is a very important dynamic in terms of the development, modernisation and progress of a society (Başkan & Çay, 2019). In this case, the connection between the present and the future of a nation is very important to be evaluated in the context of today by examining its first sources.

The history of natural sciences constitutes one of the subjects of scientific studies in the field of History of Science. Within this context, the history of mathematics in Turkey is the focus of theses, articles and papers written in the field of History of Science in our country. Within this context, master's and doctoral theses have been produced in the domain of the history of mathematics at Ankara University, Istanbul University, Fatih Sultan Mehmet University, Middle East Technical University, Uludağ University, Okan University, Yıldız Technical University, and Bilgi University. While the majority of these theses contributed directly to the discipline of history of science, those written in faculties of education analysed mathematics textbooks used in the Ottoman period in the context of educational methods and techniques (Demirhan Çavuşoğlu, 2021).

In the book titled *Eski Harfli Türkçe Matematik Biyo-Bibliyografyası (1900-1923)*, published by a group of academics working in the field of history of mathematics under the editorship of Melek Dosay Gökdoğan, Ayşe K ö k ç ü , Halime Mücella Demirhan Çavuşoğlu and Safiye Yılmaz, with the objective of examining the books on mathematics published between 1900-1923 and which served as a source in the field of mathematics in the early years of the Republic of Turkey. The process of scanning revealed 238 books by 71 authors. The book incorporates short biographies of the authors, a list of their publications, a photograph of the cover page of each book, printing information, and a full transliteration of their mukaddime (preface). Additionally, it encompasses textbooks utilised in primary, secondary and high schools (Dosay Gökdoğan, Kökçü, Demirhan Çavuşoğlu and Yılmaz Erten, 2024).

The texts used during the establishment of Turkey were Ottoman-Arabic texts, and in order to study the development of education, these texts should be transliterated into the Latin alphabet and then analysed. Looking at the studies, it can be seen that the transliterations of mathematics and geometry books written before and after the Republic have been transliterated and investigated (Ceylan, 2010; Yel, 2010; Yaprak, 2015; Takıcak, 2016; Ceylan, 2017; Duru, 2017; Arabacı, 2018; Öksüz, 2019; Yer, 2021). Due to the difficulty of transliterating and examining Ottoman texts for mathematics educators, access to and understanding of all sources has made research in this area less preferred. In order to evaluate our educational history in all its aspects, it is necessary to analyse the textbooks, which are the most basic source of the relevant course.

Kirkor Kömürçian, the author of *Yeni Hesâb (New Calculus)* and *Yeni Hendese (New Geometry)*, which are the sources of the research subject, is one of the educators who lived in the last periods of the Ottoman Empire and the first periods of the Republic of Turkey. There are 30 books of Kömürçian written in Ottoman Turkish and 12 books written in Latin alphabet (Karataş et al., 2018). The contents of the books are mostly mathematics textbooks that can be taught in vocational schools. While *Yeni Hesâb*, which was analysed in this study, is a mathematics textbook at the primary school level, *Yeni Hendese* is a geometry textbook at the secondary school level.

Who is Kömürçian?

As mentioned in the article titled "Muhasebe Eğitime Verilen Doksan Yıllık Ömür (Ninety years of life given to accounting education)", Kömürçian gave lectures and wrote books on commercial accounts and accounting in the early 20th century. He was interested in the applied field of mathematics and taught accounting, commercial accounts and financial algebra in many schools and institutions (Karataş et al., 2018).

Gürün (1948) states that Kömürçian was born on 6 March 1868 in Istanbul. Sources indicate that his father was Haçatur Efendi, a merchant in the textile industry. His education began at Kumkapı Orta Mektebi (Kumkapı Middle School) and continued at Mülkiye Mektebi (Mülkiye School) on 1 September 1883.

After graduating, he began his professional life as a teacher of Riyaziye courses at Selanik İdadisi (Thessaloniki High School). He worked as an economics teacher, deputy headmaster and vocational inspector. During his time as an inspector, he also worked as a director at Hamidiye Ticaret Mektebi Âliyesi (Hamidiye Commercial School) and continued to teach accounting courses. Later, he also lectured on commercial arithmetic and financial algebra. For 25 years, he worked in 19 different schools and 8 other courses while continuing to teach at the commercial school. It is known that he was the accountant of 6 different commercial companies.

While writing books, Kömürçian discovered innovations that made operations easier and these methods were recognised. The most important of these is the special rule he found for multiplying by 78 (Gürün, 1948). Since it was necessary to multiply the weight in kilograms by 0.78 in order to convert the weight in okka, this special rule was a very useful discovery as the okka was also used at that time. He also discovered methods for shortening transactions with the cross rule and for calculating interest in the English style (Gürün, 1948). Güvemli and Aytulun (2012) state that this discovery is known as 'Kömürçian Çapraşt Teorisi (Kömürçian's Cross Theory)' and that this theory was included in Kömürçian's book *Ticâret ve Mâlî Hesâb (Commercial and Financial Account)*, published in 1933.

Bu çalışmada Kirkor Kömürçiyân'a ait *Yeni Hesâb* ve *Yeni Hendese* isimli iki kitabın transliterasyonu yapılmış ve ilişkilendirme becerileri kapsamında incelenmiştir.

In this study, two books by Kirkor Kömürçiyân, *Yeni Hesâb* and *Yeni Hendese*, were transliterated and analysed within the scope of association skills.

Aim of the study

The aim of this study is to analyse the topics, activities, exercises and examples in the content of *Yeni Hesâb* and *Yeni Hendese* books used in mathematics and geometry courses in the late Ottoman Empire and early Turkish Republic in the context of association skills. In their study, Bingölbali and Coşkun (2016) aimed to provide a conceptual framework for how association skills can be used in mathematics education. Firstly, they highlighted mathematics and mathematics education, described the meaning of association in mathematics and, to make it more useful, limited it to four headings (association between concepts, association between different representations, association with real life and association with different disciplines).

Importance of Research

In the 19th century, the Ottoman Empire undertook many reforms in almost every field. One of these reforms was in the field of education. The İbtidâ'i (Primary School), Rüşdiye (Secondary School) and İdâdî (High School) schools, which were modelled on their Western counterparts, can be seen as an attempt to improve the quality of education. However, there was a problem with the lack of qualified textbooks to be taught in these schools. A large number of textbooks were written in a short period of time with the outstanding efforts of young people who had been educated abroad and returned to the country to work in high-level government positions, teachers working in Darülfünun (Istanbul University) and engineering schools, and teachers who had graduated from these schools. Textbooks written for all levels of the new educational institutions by important names of the late Ottoman educational and scientific community such as Salih Zeki, Hüsnü Hâmid, Mehmet İzzet, Kirkor Kömürçiyân, Salih Murad Uzdilek, Hasan Fehmi Çayköy were taught in Ottoman schools.

With the establishment of the Republic of Turkey, efforts to move towards a scientific and modern education system gained momentum with the establishment of the Heyet-i İlmiye under the Ministry of Education. The Heyet-i İlmiye, which operated between 1923 and 1926, held its first meeting between 15 July and 15 August 1923 and made important decisions regarding the education system. In fact, the Tevhid-i Tedrisat Law of 3 March 1924 brought all educational institutions under the Ministry of Education and corrected the complex structure of the Ottoman education system. Some Ottoman textbooks were used in the early years of the Republic. After the alphabet reform, they were translated into Latin letters and continued to be used for a while. Books by famous mathematicians such as Salih Zeki, Mehmet İzzet, Hüsnü Hamid and Kirkor Kömürçiyân's *Yeni Hesâb* and *Yeni Hendese* were chosen as mathematics textbooks to be taught in the educational institutions of the newly established state.

By analysing the mathematics and geometry books selected for the study, information about the mathematics education of the period will be obtained. In addition, it will try to understand how effective the books can be in the field of education by looking at the types of association skills in the books used in the late Ottoman and early Republican periods. Through mathematical association, students will achieve positive outcomes such as comprehension, meaning making, making connections between previous learning and new learning, and providing continuous learning (Ball et al., 2005). Considering all these situations, Kirkor Kömürçiyân's textbooks *Yeni Hesâb* and *Yeni Hendese* were considered worthy to be analysed within the framework of this thesis.

What is Association Skill?

The relationship between one mathematical entity and another mathematical or non-mathematical entity can be summarised as a mathematical association (Singletary, 2012). It is very important to teach mathematical association skills in the mathematics curriculum (NCTM, 2000). While explaining the importance of mathematical association in the curriculum, it is mentioned that they are working on a curriculum that is integrated with other disciplines and daily life around values, skills and competencies related to the use of metacognitive skills, ensuring meaningful and sustained learning, solid and previous learning (MEB, 2018).

Bingölbali and Coşkun (2016) developed a conceptual framework consisting of four main components by examining the NCTM (2000) and MEB (2013) programmes and reviewing the relevant literature, in order to better understand and systematise mathematical association skills. Several other studies have been conducted using this framework (Ece, 2021; Özđiner, 2021; Tartan, 2021; Yavuz Mumcu, 2018). These four main components can be explained under the following headings:

1. Associations between concepts: Mathematics was found to be rich in terms of seeing relationships between concepts, both because of its progressive topics and its nature (Bingölbali & Coşkun, 2016). Concepts were seen in two types of relationships. The first is the relationship established between the concepts themselves. An example of this is the explanation of even and odd numbers from the learning domain of numbers and operations in the content of sequential numbers, which belongs to the learning domain of numbers and operations. The other is the relationship between different concepts. The most common example of this can be the use of decimal representations from the numbers and operations domain when calculating a volume operation belonging to the geometry measurement domain. In short, interconceptual association is the association of one mathematical concept with another mathematical concept (Li, 2020). In this study, the nature of interconceptual association was evaluated through the two components proposed by

Dilegelen (2018) and Ünal (2023): Establishing a relationship between two different learning domains and establishing a relationship between the same learning domain.

2. Associating connections between different representations of concepts: Different representations are the repeated demonstration of a mathematical expression or concept in more than one form, such as symbolic, graphical, verbal mathematics, etc., to ensure that the student is exposed to the concept in different ways and multiple times (Prain & Waldrup, 2006). In the process of association between different representations of the concept, there should be at least two different representations of the concept (Bingölbali & Coşkun, 2016). This association is used to define the mathematical relationship between different representations of the same concept (Li, 2020). Li (2020) divided the representations into 6 categories: written symbols, verbal expression, figure or diagram, table, graph, and formula. Different representations of a mathematical concept can be expressed as verbal explanation, context, symbols, table and graph (Van de Walle et al., 2013). In this study, the representations used in the analysis of different representations of concepts are based on the studies of Bingölbali and Coşkun (2016), Dilegelen (2018) and Ünal (2023): Verbal expression, table, graphic, symbolic expression, concrete object and model representation. For example, when explaining the concepts of half, quarter and whole, half, quarter and whole of a loaf of bread are given as a picture or concrete object, and when the meaning of each of them is expressed verbally, the use of different representations is seen. If each is expressed as a fraction (e.g. $\frac{1}{2}$ for half, $\frac{1}{4}$ for quarter), a symbolic representation is also used.
3. Associating with other disciplines: Linking with other disciplines means presenting mathematical concepts, rules and symbols in the context of other disciplines. Connections to other disciplines such as life sciences, music, science, etc. are sought. The aim is to develop high-level cognitive skills and to increase the retention of learning through established relationships (Johansen, 1991). In the context of this research, the framework of Özdiner (2021) has been used for interdisciplinary linking. In this context, the use of concepts or rules from other disciplines to teach mathematical concepts, the use of other disciplinary contexts as mathematical problem situations, and the establishment of verbal relationships with the concepts of other disciplines in mathematics teaching were considered in the process of making links with different disciplines. As an example of different disciplines, in the conversion of liquid units of measurement in the mathematics content, liquids such as olive oil and water were used and compared, and which one was denser was mentioned in relation to the discipline of science.
4. Associating with real life situations: Associating with real life situations is the handling of mathematical concepts, expressions, rules and problems in relation to everyday life. According to the information in the curriculum, when students see a situation in a mathematics textbook that they have experienced or are likely to experience in real life in a short period of time, it is easier for them to make sense of it and use the information in their daily life after learning (MEB, 2018). Another aim of mathematics is to transform students into individuals who can solve the problems they encounter in real life, acquire analytical intelligence, develop solutions while thinking, and actively use technology (Tanju, 2020). As part of associating with real life, the framework of analysis identified by Gainsburg (2008) was used. Within the category of simple analogies in this framework, mathematical concepts are explained through concepts that are simulated in real-life situations during the teaching process. Examples of real-life situations include problems related to counting desks in a classroom. Examples from everyday life can be used such as weather forecasts used in real life when explaining negative and positive numbers, shopping receipts when explaining decimal notation.

METHOD

This research used the method of document analysis, one of the qualitative approaches. Qualitative research is defined as "a research approach that follows a qualitative process to reveal perceptions and events in a realistic and holistic way in a natural setting using qualitative information gathering methods such as observation, interviews, and document analysis" (Yıldırım & Şimşek, 2008). Document analysis involves the systematic examination of written or printed materials that contain information appropriate to the purpose of the research (Wach & Wach, 2013). After the transliteration of the *Yeni Hesâb* and *Yeni Hendese* books, the topics, activities, exercises and examples were grouped within the analysis framework related to the association between concepts, interdisciplinary association and association with real life. The identified analysis framework is presented in Table 1:

Table 1. Types of association analysis frameworks

Association Type	Components/Indicators	Example
Association between concepts	Associating between the same learning area	Association between ratio and percentage
	Associating between two different learning areas	Working out the equation for the volume of a cube using the area ratio
Associating with different	Verbal expression	Association a given verbal expression to other mathematical expressions

Association Type	Components/Indicators	Example
representations of concepts	Table	Association tables, tally sheets, binary frequency tables, etc. to other mathematical expressions
	Graphic	Graph, circle graph, coordinate axis graph, column graph, line graph, etc. Associating graphs to other mathematical expressions
	Symbolic expression	Algebraic expressions, equations, representation of fractions, representation of exponents, side-by-side multiplication of exponents, etc. Associating representations to other mathematical expressions
	Tangible object	Associating concrete objects such as fraction cards, pencil, paper, cake, pizza, etc. with mathematical expressions.
	Model	Associating models such as area model, region model, number line model, set model, etc. with other mathematical expressions
Interdisciplinary association	Using concepts or rules from other disciplines to teach mathematical concepts	The concepts of seasons and months in life science are used as a background to units of time.
	Using other disciplinary contexts as problem situations	Using the map of Turkey in a problem requiring area calculation
	Establishing a verbal relationship with concepts from other disciplines	Expressing only verbally that geometric objects are used in architecture
Associating with real life	Simple analogies	Associating negative numbers with freezing temperatures
	Classical problems	Trains leaving the same station
	Analysing real data	Finding the mean and median of classmates' heights
	Discussing mathematics in society	Distortion of statistical results for the purpose of directing public perception
	Practical demonstrations of mathematical concepts	Models of smooth bodies, cubes
	Mathematical modelling of real-life events	Writing a formula using a function to find the temperature on a particular day of the year

Selection of Textbooks

The textbooks inherited from the late Ottoman period to the early Republican period can be called 'transitional' textbooks. In this case, the textbooks that were taught in both the Ottoman and Republican periods were specified in the report of the Textbooks Review Commission, which was convened in 1924. One of the textbook authors of this period, K  m  rciyan, whose textbooks were entitled *Yeni Hes  b* and *Yeni Hendese*, was considered worthy of examination in this study.

In the late Ottoman period, an educational movement called 'us  l-i cedid' emerged, which was open to innovations in education and aimed not to lag behind the times (Aydemir, 2024). In this context, the term 'new' was used in most of the titles of the books written. The innovations in education that started with the Tanzimat Edict were implemented as a process of modernisation in education in the following periods. First, schools were opened to train teachers who could provide modern and well-equipped education, and then the use of new teaching methods was taken into consideration in the writing of textbooks (Aydemir, 2024). It can be said that the fact that the titles of the two books selected in this study, which were approved for teaching in the classrooms by writing books during these periods, begin with 'new', leads to the conclusion that K  m  rciyan proceeded within the framework of the us  l-i cedid movement. Information on the textbooks is given in Table 2:

Table 2. Information about textbooks

Title of the Book	Author name	Number of pages	Publisher	Year of publication
<i>Yeni Hesâb</i>	Kirkor Kömürçiyân	156	Suhûlet Bookshop on Bab-ı Ali Street, Istanbul	Gregorian 1925
<i>Yeni Hendese</i>	Kirkor Kömürçiyân	90 (3rd book could not be accessed)	Suhûlet Bookshop on Bab-ı Ali Street, Istanbul	Gregorian 1925

Selection of content to be analysed

The content distribution of the *Yeni Hendese* book has less content than the *Yeni Hesâb* book, both because it is a geometry book and because the whole book could not be accessed. The distribution of the analysed contents according to textbooks is shown in Table 3. A total of 880 contents were analysed in the textbooks. While 689 of these contents are in the *Yeni Hesâb* textbook, 191 of them are in the *Yeni Hendese* textbook.

Each activity, lecture, exercise and example in the textbooks was prioritised, categorised and classified according to its analysis framework. All activities were then reviewed with an expert in mathematics education and a final decision was made on the classification of the activities after a joint decision was reached for each activity. After all categorisations were made, frequency tables of the activities were created and transformed into findings.

Table 3. Distribution of content examined in textbooks

	Subject Description/Activity	Example	Exercise	Total
Yeni Hesâb	60	132	497	689
Yeni Hendese	73	52	66	191

Data Analysis

Kömürçiyân's book titled *Yeni Hesâb* was obtained from Atatürk University Library, Seyfettin Özege Collection and his book titled *Yeni Hendese* was obtained from Galatasaray University Library, Rare Works Collection in PDF format by the researcher. The Ottoman Turkish books were then transliterated into modern Turkish by the researcher with the help of an expert. The activities, topics, exercises and examples in the books were analysed according to the established framework of analysis and divided into categories and classes.

A total of 880 items in the textbooks were classified according to the analysis framework defined by the researcher and the mathematics expert. The coding was done independently and the Miles and Huberman (1994) reliability coefficient was calculated as 88% as a result of the first coding. The researcher and the expert then met and discussed the codings that caused differences and a consensus was reached.

The association with the associative skill in Figure 1 was identified. It was found that there was a relationship between sequential numbers and subtraction in the same two learning domains. A similar situation was found for addition and multiplication, and the coding was similar.

SUBTRACTION TABLE		
1-1=0	4-4=0	7-7=0
2-1=1	5-4=1	8-7=1
3-1=2	6-4=2	9-7=2
4-1=3	7-4=3	10-7=3
5-1=4	8-4=4	11-7=4
6-1=5	9-4=5	12-7=5
7-1=6	10-4=6	13-7=6
8-1=7	11-4=7	14-7=7
9-1=8	12-4=8	15-7=8
10-1=9	13-4=9	16-7=9
2-2=0	5-5=0	8-8=0
3-2=1	6-5=1	9-8=1
4-2=2	7-5=2	10-8=2
5-2=3	8-5=3	11-8=3
6-2=4	9-5=4	12-8=4
7-2=5	10-5=5	13-8=5
8-2=6	11-5=6	14-8=6
9-2=7	12-5=7	15-8=7
10-2=8	13-5=8	16-8=8
11-2=9	14-5=9	17-8=9
3-3=0	6-6=0	9-9=0
4-3=1	7-6=1	10-9=1
5-3=2	8-6=2	11-9=2
6-3=3	9-6=3	12-9=3
7-3=4	10-6=4	13-9=4
8-3=5	11-6=5	14-9=5
9-3=6	12-6=6	15-9=6
10-3=7	13-6=7	16-9=7
11-3=8	14-6=8	17-9=8
12-3=9	15-6=9	18-9=9



Figure-1. Connection between the subtraction ruler and consecutive numbers (Kömürçiyân, 1925, p.42)

In the book *Yeni Hesâb*, examples such as 'A child spends 5 kuruş a day. How many kuruş is this child's weekly expenditure?', relationships were observed with the learning domain of numbers and operations such as addition, subtraction and multiplication (Kömürçiyân, 1925, p.66). In this example, it was coded as a relationship between the same two learning domains and added to the table.

Figure 2 shows an example of the relationships between geometry-measurement and algebra, which are different learning areas in the *Yeni Hendese* book. For the relations between geometry-measurement and algebra learning area, circle circumference and area, cylinder volume, cone volume and area, Pythagoras, volume and area of piles of stones and sphere volume and area are among the other contents in the book. The formulas in the solved examples are also used.

Definition.—If we call the main line of the cone L , its height A , and the radius of the base r , its formula is:

Field layer of the cone $= \pi \times r \times L$

Total area of the cone $= \pi \times r \times L + \pi r^2$

And the volume of the cone $= \frac{\pi r^2 \times A}{3}$ is it possible.

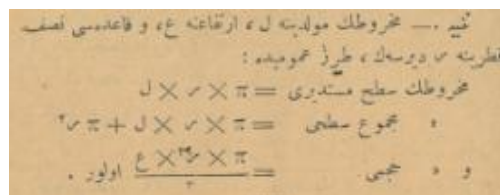


Figure -2. The relationship between the fields of geometry, measurement and algebra (Kömürçiyân, 1925, p. 4)

FINDINGS

In this study, the association skills in the teaching processes in Kömürçiyân's *Yeni Hesâb* and *Yeni Hendese* books are analysed as interdisciplinary, different representations, real-life and interconceptual. These relationships were analysed separately as example-exercises and lecture-activities due to the layout and content of the books. According to the data in Table 4, interdisciplinary associations are included less ($f=46$, 5%) than other types of associations. However, other types of associations were included in textbooks to a significant extent (between 26% and 36%). When analysing the distribution of associations in textbooks according to content types, it can be seen that associations between real life and concepts are more preferred in example/exercise applications, whereas associations with different representations and real life are significantly used in lecture/activity type content. In the following section, the findings on how the types of associations are handled in the context of each book are detailed.

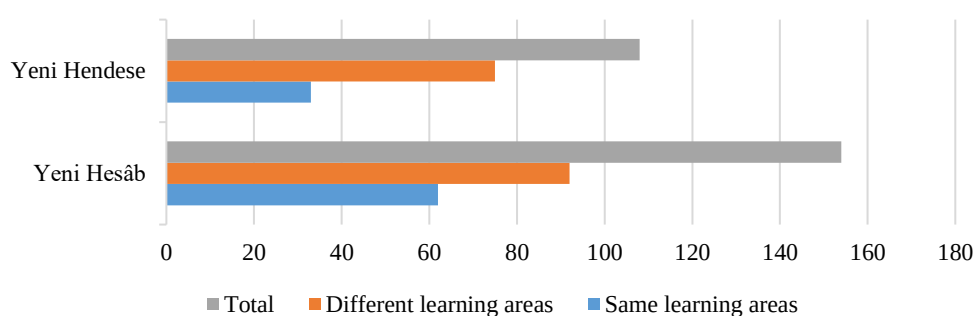
Table 4. Number of associations in textbooks

	Example/Exercise	Lecture/Activity	Total
Interdisciplinary	42	4	46 (%5)

	Example/Exercise	Lecture/Activity	Total
Different Representation	12	306	318(%36)
Real Life	112	121	233(%26)
Between Concepts	170	89	262 (%29)

1. Associations between concepts

This study analysed the associations between concepts belonging to the same learning domain and between concepts belonging to different learning domains, which are two subcategories of the association between concepts. The results are shown in Figure 1. As can be seen in the Graph-1, while in *Yeni Hendese* there are associations between concepts in the majority of the analysed content ($f=108$, 56%), this rate is lower in *Yeni Hesâb* ($f=154$, 22%) despite more content. However, in both textbooks, associations between different areas of learning are more frequent.



Graph -1. Associations between concepts in textbooks

The *Yeni Hesâb* book includes the learning areas of numbers and operations, geometry and measurement, and data processing because of the grade levels it addresses. The reason why algebra was not included in the analysis was that the *Yeni Hesâb* book was written for primary schools and did not include algebra. Table 5 shows the data:

Table 5. Associated learning areas in book *Yeni Hesâb*

	Numbers and operations	Geometry and measurement	Data processing
Numbers and operations	60 (%9)	83(%12)	
Geometry and measurement	9 (%1)	2(%0,3)	
Data processing			

In the *Yeni Hesâb* book, examples of money measurement and time measurement are often used in the exercise questions in the relations between numbers and operations and in the learning area of geometry and measurement. These associations are as follows: How many kuruş do a worker who earns 870 kuruş and a worker who earns 465 kuruş earn per week?; How many kuruş do 23 okka potatoes cost at 4 kuruş per okka?; A worker's daily wage is 120 kuruş. How many kuruş will he earn in a week if he works all day?" (Kömürçyan, 1925, pp.117-121).

When the multiplication operation was explained, it was associated with the addition operation and an attempt was made to provide meaningful learning. Then the numerical data was again explained verbally. In Figure 3 it can be said that a relationship was established between the learning domains of addition and multiplication. The same situation is present in the explanation of the division operation. It can be seen that a relationship has been established between division and subtraction.

$$\begin{array}{ll} 3+3=6 & 3 \times 2=6 \\ 3+3+3=9 & 3 \times 3=9 \\ 2+2+2+2=8 & 2 \times 4=8 \end{array}$$

In this form $2 \times 3=6$, we understand that the number 3 will be repeated twice. And 2 times 3 means, which we read as 3 times 2.

So we understand that the multiplication of $3 \times 3=9$ will be 3 times repeated and added. And we read it as 3 times 3 equals 9.

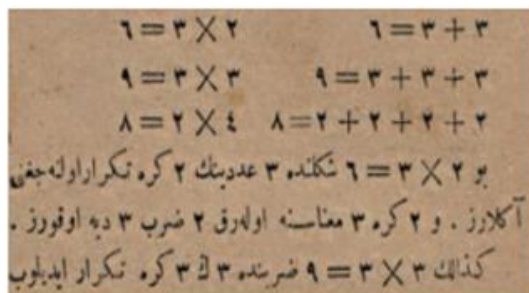


Figure -1. The relationship between multiplication and addition (Kömürçüyan, 1925, p.14)

Since the *Yeni Hendese* book includes geometry, the content related to the computing domain was not included. The reason for including the algebra learning domain is that *Yeni Hendese* is a book written for grades 3, 4, and 5 and is close to the middle school level according to that period (Karataş et al., 2018). According to Table 6, the learning domain most related to the geometry and measurement learning domain was numbers and operations (F=63, 33%), while the least related domain was algebra (F=12, 6%).

Table 6. Associated learning areas in book *Yeni Hendese*

	Numbers and operations	Algebra	Geometry and measurement
Numbers and operations			
Algebra			
Geometry and measurement	63 (%33)	12 (%6)	33 (%17)

Among the examples in the *New Hendese* book, the most common case was the inclusion of decimal notation in questions on a topic such as cylinders and circles, selected from the content of geometry and measurement in the relationships between different learning. Figure 4 is given as an example:

42— Volume of a cylinder —To find the volume of a cylinder, multiply the area of its base by the height.

For example, if you need the volume of a cylindrical copper container with a base diameter of 42 centimeters and a height of 85 centimeters, the volume of such a container will be found in liters, that is, in cubic decimeters, and the height will be found in liters, i.e., in cubic decimeters, by converting the size to decimeters and performing the necessary operations:

$$4,2^2 \times 3,14 \times 8,5 = 17,64 \times 3,14 \times 8,5 = 55,3896 \times 8,5 = 47081,160$$

liter result is found.

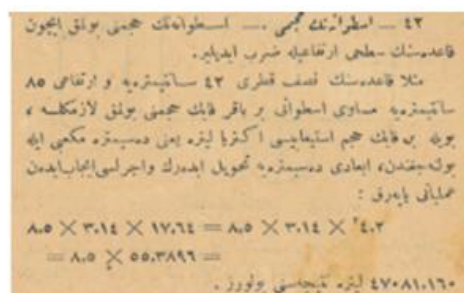


Figure-2. The relationship between geometric measuring area, liquid measuring area and decimal notation (Kömürçüyan, 1925, p.45)

2. Associations between different representations of concepts

The information contained in the concept can be provided through the use of different representational tools. These tools are verbal, tabular, graphic, symbolic, concrete object and model representations. Different representation tools can also be used to teach, reinforce and fully understand the concept. Table 7 shows that there is a relationship between three different representations in the *Yeni Hesâb* book. Among the different concept representations, the relationship between concrete object and verbal expression was the most common (f=64, 9%), while the relationship between verbal expression was the least common among the same concept representations (f=24, 4%). Graphic and model were among the representations that were not encountered at all.

Table 7. Conceptual representations associated with the *Yeni Hesâb* textbook

	Verbal expression	Tangible object	Symbolic expression	Table	Model	Graphic
Verbal expression	26 (%4)	2 (%0,3)	15 (%2)	3(%0,4)		

	Verbal expression	Tangible object	Symbolic expression	Table	Model	Graphic
Tangible object	64 (%9)	8 (%1)	7 (%1)			
Symbolic expression	27 (%4)					
Table						
Model						
Graphic						

Concrete objects are used in many places in the *Yeni Hesâb* book when giving examples while explaining the subject. These concrete objects are usually books, fruit, vegetables, dominoes and money. When the subtraction process is to be explained, the concrete object of apple is drawn first, the subtraction of 4 apples from 7 apples and the verbal expression of the operations performed are shown as in Figure 5.

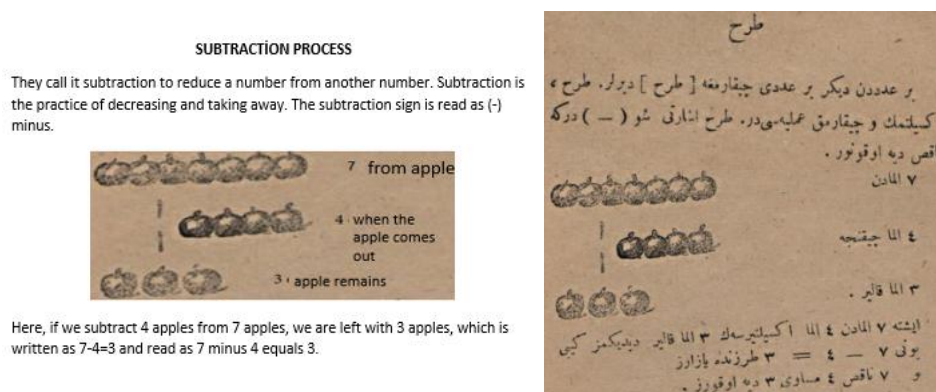


Figure 5. Transition from concrete object to verbal expression (Kömürçiyân, 1925, p.11, 12)

There are two examples where verbal expressions are given first and then supported with a concrete object. One of the two examples is a concrete object in Figure 6, where an empty bird cage is given immediately after the concept of zero is explained. The fact that there is no bird in the cage is called zero bird and it is expressed as '0' with a number, which is a verbal expression. Kömürçiyân made the transition from a verbal expression to a concrete object with the following example:

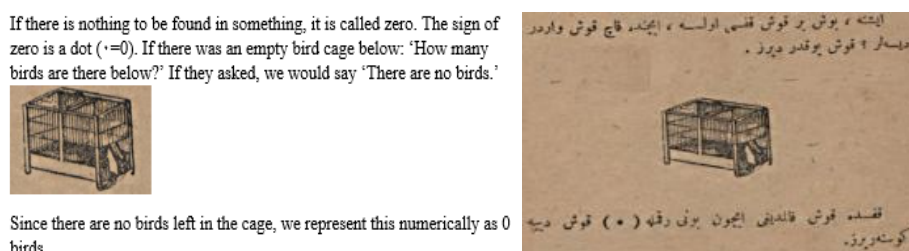


Figure 6. The transition from verbal expression to concrete object (Kömürçiyân, 1925, p. 6)

Yeni Hendese textbook is quite rich in terms of associated concept representations ($f=165$, 86%). The highest relationship between the different representations in Table 8 was found between verbal expression and model ($f=31$, 16%), and the lowest relationship was found between verbal expression and table and model and table ($f=2$, 1%). All figures in the book were attempted to be drawn by hand according to the measurements. Graphical representation between different representations was not found in any content of the book:

Table 8. Conceptual representations associated with the *Yeni Hendese* textbook

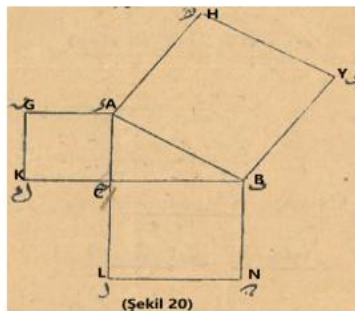
	Verbal expression	Table	Graph	Symbolic expression	Tangible object	Model
Verbal expression	16 (%8)	2 (%1)		21 (%11)	6(%3)	31 (%16)

	Verbal expression	Table	Graph	Symbolic expression	Tangible object	Model
Table						
Graph						
Symbolic expression	3 (%2)				3 (%2)	10 (%5)
Tangible object	4 (%2,1)			4 (%2,1)		6 (%3)
Model	14(%7)	2 (%1)		14 (%7)	6 (%3)	24(%13)

In the *Yeni Hendese* book, the calculation of the hypotenuse using triangle areas is explained, which is the hypotenuse relation of Pythagoras. The model is used, explained verbally and illustrated with symbols. There is a general answer to the question, suitable for the symbolic expression given:

20—Special Cases of Right-Angled Triangles—A right-angled triangle and a right-angled square are equal to the sum of the squares of their sides. For example, the square BAHY drawn on the hypotenuse BA of the right-angled triangle BCA (Figure 20) is equal to the sum of the square BCLN drawn on the vertical side BC and ACKG drawn on the vertical side AC. This is explained in the following expression.

$BAHY=BCLN+ACKG$ or $(BA)^2 = (BC)^2 + (AC)^2$ we write.



Here $CA=2$, $BC=5,3$, $BA=4,032$ even if it were meters,

$(4,032)^2 = (3,5)^2 + (2)^2$ If we calculate it would be,

$16,25 = 12,25 + 4$ it is possible.

And true $16,25=16,25$ has equality.

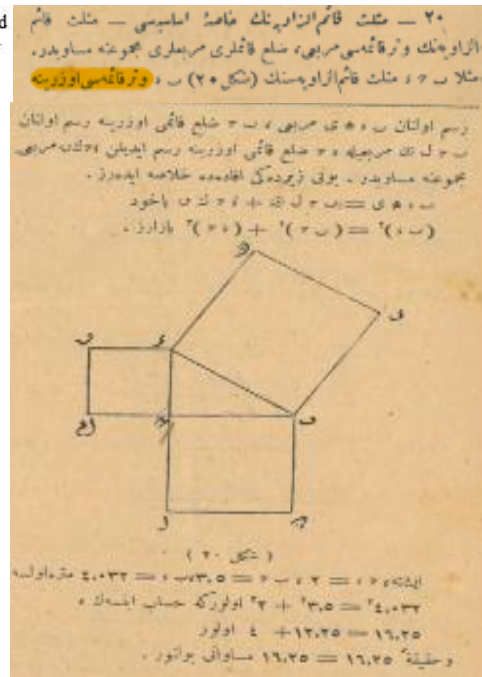


Figure 7. Transition from verbal expression to modelling (Kömürçüyan, 1925, p.20)

Among the sentences that were often used during the teaching of the *Yeni Hendese* subject, there were reminders that the subject had been explained in previous years. At the same time, the teacher encouraged students to use symbolic expressions when answering questions. Figure 8 shows an answer to a question about symbolic expressions:

[1] Mr. teacher, should print the letters representing the vertical points of the curve from the figure.

$$BBC' \text{ Triangle} = \frac{BC' \times CC'}{2} = \frac{6 \times 7}{2} = 21 \text{ square centimeter.}$$

$$CC'AA' \text{ Trapezoid} = \frac{(CC' \times AA') \times CA'}{2} = \frac{(8 \times 7) \times 9}{2} = 67,50$$

$$AA'HH' = \frac{(AA' \times HH') \times A'H'}{2} = \frac{(8 \times 11) \times 7}{2} = 66,50$$

$$HH'YY' = \frac{(HH' \times YY') \times H'Y'}{2} = \frac{(11 \times 6) \times 5}{2} = 42,50$$

$$YY'G' = \frac{YY' \times YG'}{2} = \frac{3 \times 6}{2} = 9$$

$$GNN' = \frac{(GN' \times NN') \times N'N'}{2} = \frac{5 \times 2}{2} = 5$$

$$NN'MM' \text{ Trapezoid} = \frac{(NN' \times MM') \times N'M'}{2} = \frac{(5 \times 7) \times 9}{2} = 30$$

$$MM'LL' = \frac{(MM' \times LL') \times M'L'}{2} = \frac{(7 \times 6) \times 15}{2} = 97,50$$

$$LL'B \text{ Triangle} = \frac{LL' \times LB'}{2} = \frac{6 \times 4}{2} = 12$$

$$BCAHHYGNML \text{ area} \dots\dots = 375.$$

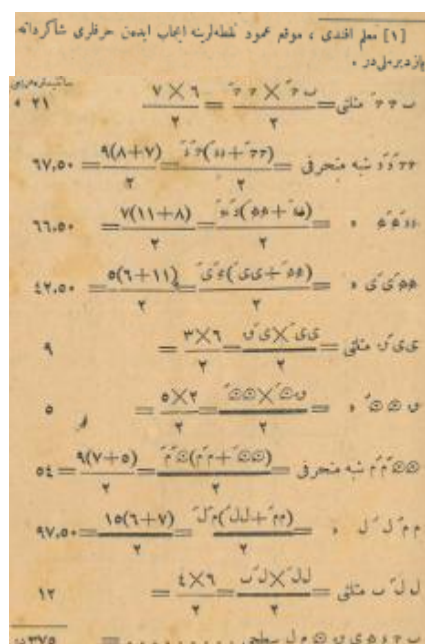
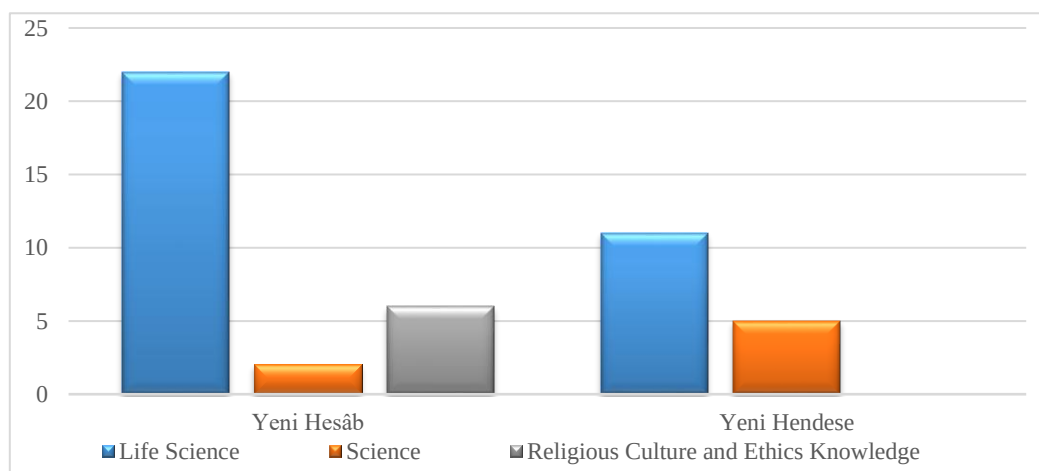


Figure 8. Use of symbolic expressions (Kömürçiyân, 1925, p. 26)

3. Interdisciplinary associations

In both textbooks, the least interdisciplinary association was observed ($f=46$, 5%). Graph 2 shows the disciplines with which mathematics and geometry are associated in the textbooks. In the *Yeni Hesâb* textbook, the highest number of associations between mathematics and other disciplines ($f=22$, 3%) was found with the life science course, while in the *Yeni Hendese* textbook, more associations were found with life science ($f=11$, 6%) than with other disciplines:



Graph-2. Disciplines associated with mathematics in textbooks

Associations were found with calculations such as hours, minutes, days and months, which are part of the life sciences learning outcomes. These associations are mostly found as questions in the content of the exercises: 'February has 28 days. How many weeks are in February?; How many weeks are in 45 days and how many days are in 45 days?; How many days are in 8 weeks?; How many weeks are in 63 days?' (Kömürçiyân, 1925, p.73,87). Only one example with its solution is included in the section on divisional expressions. The third division example in Figure 9 has a content that deals with the concept of time, which is one of the

topics of life science. After the problem, the operations were carried out and then verbal explanations were given. In this context, a relationship was established between mathematics and the life science discipline:

Example-3 The daily income of a family father who spends 968 penny per week How much does it cost?

Since there are 7 days in a week, the daily cost decreases 7 times from 968 penny. This Therefore, to find the daily expense, it is necessary to divide 968 penny by 7. Here is the application

$$\begin{array}{r} 968 \overline{) 7} \\ \underline{7} 138 \\ \underline{26} \\ 21 \\ \underline{58} \\ 56 \\ \underline{2} \end{array}$$

It is applied in the style.

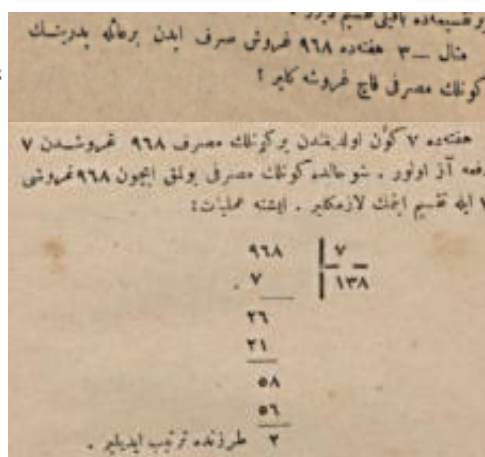
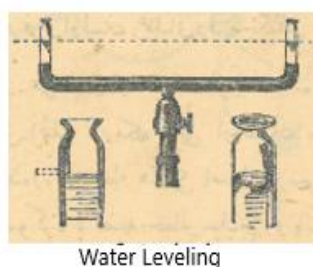


Figure 9. Relationship between mathematics and life science disciplines (Kömürçian, 1925, pp. 123, 124)

In the book *Yeni Hendese*, there is a reference to water levelling, which is used by engineers to measure the height of land. Water levelling is related to science as a working principle and geography as a field of application. Figure 10 gives information about what water levels are made of and their size. It then goes on to explain in detail how water levelling is used and illustrates this with the picture below. It also explains how to make these measurements for a plot of land, the mathematical values of which are given:

74—Water Leveling Device— It consists of a tank or a pipe made of brass, approximately 1.20 meters long and 3.2 centimeters wide.



Water Leveling



Figure 10. The relationship between geometry and scientific disciplines (Kömürçian, 1925, p. 88)

4. Associations with real life situations

In *Yeni Hesab*, classical problems that deal with real-life situations were found more often than any other situation ($f=135$, 20%). Table 9 shows that in the *Yeni Hesab* book, relationships appear in every option except the discussion of mathematics in society and the examination of real events. In the *Yeni Hendese* book, simple analogies, analysis of real data, discussion of mathematics in society and mathematical modelling of real events were not encountered.

Table 9. Distribution of real-life associations in textbooks

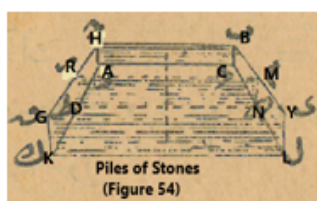
	<i>Yeni Hesab</i>	<i>Yeni Hendese</i>
Simple analogies	19 (%3)	0 (%0)
Classical problems	135 (%20)	16 (%8)
Examine real data	52 (%8)	0 (%0)
Discussion of mathematics in society	0 (%0)	0(%0)
Practical demonstrations of mathematical concepts	4 (%0,6)	7 (%4)
Mathematical modelling of real events	0 (%0)	0 (%0)

When analysing the classical problems related to real life in the *Yeni Hesâb* textbook, it is seen that these associations are found in every subject content and exercises, even with a question or an example. Among these exercises, there are questions like the following, and it is possible to multiply them.

A person sells a pair of chairs for 58 kurus. How much profit would he make if he bought one of them for 24 kurus?; If a room has seven windows and each window has 8 panes of glass, how many panes are there in the room?; If 3 okka of walnuts are given for 64 kurus, how many kurus would they cost per okka?; How many kurus would a worker who earns 870 kurus a week and spends 465 kurus collect at the end of the week?; I bought 45 socks for 945 kurus. I gave 21 of them to my neighbour and received 651 kurus. I wonder how many socks I have left and how many kurus are these remaining socks worth? (Kömürçiyân, 1925, p.80,125).

In the *Yeni Hendese* book, classical problems were found more often (f=16, 8%) than the other cases in the same book content. In terms of subject expression content, it contains more real-life elements than the other book, but examples of real-life elements were found less in terms of practice problems. Contents such as finding the volume of piles of stones, finding the volume of a hollow tree, finding the volume of a barrel of needles contain real life elements:

Example 1. —Finding the Volume of Stone Pile-



The stones they will use on the roads are generally used as shown here, with a rectangular side base (Figure 54), and then they calculate their volume, which they call application. To perform this process, the bottom base is examined.

Rule— The sum of the upper and lower bases is 4 times the volume of the middle base, which is equidistant from these bases, and by multiplying the height of the sum, they get one-sixth of the multiplication result.

Now, if we call the BHAC layer at the top as G, the YGKL layer at the bottom as G', and the MRDN layer in the middle as G'', our rule is:

$$\frac{A}{6} (G + G' + 4G'') \text{ it is possible.}$$



Figure 11. An example with a real element (Kömürçiyân, 1925, pp. 55, 56)

In the *Yeni Hesâb* book, the examination of real data is the most common real-life association (f=52, 8%) after classical problems. In this context, there are contents in both lectures and exercises: "Count the desks in the classroom. Say how many desks there are. How many fingers do you have on your hand? Close your hand. Then open one finger. Show two fingers. Show the numbers from one to nine with your fingers. (Kömürçiyân, 1925, p.6,7). In the exercises on fractions, the question about the half of a mecdiye again gives the result of a real data used in real life.

Another pattern of questions in the book of *Yeni Hesâb* is: "An hour is sixty minutes. How many minutes is half an hour and how many minutes is a quarter of an hour?" (Kömürçiyân, 1925, p.135). Half and quarter are examples of simple analogies often used in everyday life.

In the *Yeni Hendese* book, there was no case of analysing real data, but there were more applied demonstrations of mathematical concepts (f=7, 4%) than in the other book. For example, questions on geometric concepts in the *Yeni Hendese* book include "How can you divide a right angle into three equal parts? How can you draw a triangle whose base (rule) and angle in the drawing are known, if they are assumed to be equal? Can a triangle be drawn where one side and the angles of its neighbours are known?" (Kömürçiyân, 1925, p.10).

Real-life associations draw attention to the contexts in their content. As can be seen in Table 10, the most common theme (f=47, 7%) among the themes created are the contexts related to shopping in the *Yeni Hesâb* book. Examples of calculations involving the currencies of the period such as kurus, mecdiye and yarımlik (halves) are quite common. Currencies were used in all the examples given in the explanation of numbers between 1 and 1000. These types of calculations were also frequently included in the practice questions. Other topics with real-life associations are categorised as food, occupation and goods in Table 10 below:

Table 10. Contexts included in textbooks with real-life connections

Themes	<i>Yeni Hesâb</i>	<i>Yeni Hendese</i>	Examples of context used
Shopping	47 (%7)	3 (%2)	Objects in the theme of food and goods are money, kuruş, mecdiye, half, Quran, elifba, brother, child, aferin paper.
Food	34 (%5)	3 (%2)	Melon, potato, apple, onion, watermelon, sugar, oil, onion, potato, vinegar, hazelnut, walnut, cherry, pastry, egg, apricot, peach, grape, olive oil, fish, bread, salt, lemon,

Themes	Yeni Hesâb	Yeni Hendese	Examples of context used
			rice, mulberry, fig, bean, milk, sugar, medlar, drink, mushroom, melon, oleaster, water.
Job	10 (%2)	3 (%2)	Blacksmith, farmer, judge, shoemaker, herbalist, teacher, architect, engineer, shopkeeper, clothier, worker, civil servant, baker, tailor
Furniture	28 (%4)	33 (%17)	Classroom desk, bookcase, marble, domino, notebook, carpet, bedstead, suit, carpet, fabric, bucket, chair, zurna, rod, scale, meter, tin can, basket, lamp lantern, candy box, rubber band, balloon, goods chest, stove pipe, backgammon dice, okka, tin, compass, architect's square, pennant, stake, square foot, foot square, water level, person, barrel, paper, marble sack, railing, window, bookcase, kerosene, ruler, stone, water glass, iron bullet, iron bar, gold wire, copper sphere, writing desk.

The contexts related to the shopping theme are related to all other themes. Regarding the real-life association between salt, bread, lemon, which is the context of the food theme, and kurus, which is the context of the shopping theme: "Salt costs 5 kurus per ounce. How many okka of salt can I buy with 8 kurus?; How many kurus do 2 loaves of bread cost at 6 kurus and 5 lemons at 1 kurus?" (Kömürçian, 1925, p.18,45).

There are also exercises related to food that do not involve shopping. Several pictures of food were drawn and asked to be counted, and examples of four operations were also used. When analysing the question in Figure 12 below, the pictures of food were first drawn and then counted and shown. In this way there are different examples where pictures of food and operations are used in both the exercises and the lecture content:



How many cherries do you see individually in the picture and how many cherries are all of them? Again, how many individual medlars do you see in the same picture and how many medlars do they all make? Show them with numbers and signs.

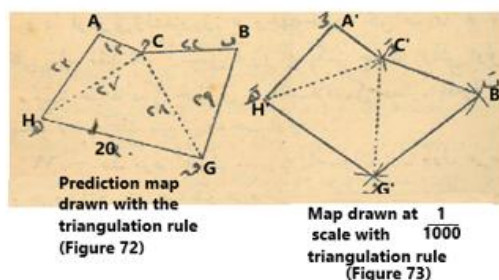


Figure 12. Real life relationships food theme contexts (Kömürçian, 1925, p. 7)

The content related to shopping in the *Yeni Hendese* book is included in the practice questions and less ($f=3$, 2%) than in the other book. The examples related to this topic were treated by combining them with the context of goods: "How many Kurus is the cost of a chest of goods with a length of 0.60 metres, a width of 0.50 metres and a height of 0.40 metres at 18 Kurus per square metre?" (Kömürçian, 1925, p.61). Looking at the examples, there is an exchange to be calculated in kurus.

In the *Yeni Hendese* book, there is content related to the use of the compass in the Expression-Activity sections. Figure 13 below gives an example of the rule of triangulation in map drawing and how to do it using a compass:

For this, we take a 23-millimeter line A'H' with a ruler board (Figure 73). Then we open the caliper by 12 millimeters and draw a small arc around point A'.



Thus, we open the compass 27 millimeters and draw a second section around point H', cutting it at a point like C', and create the lines C'H', C'A'. This means that a small section should be drawn and applied around point H' with a radius of 30 millimeters and around point C' with a radius of 28 millimeters, and the intersection point G' and points H', C' are found, that is, created. Then, two small intersections were drawn around point G' with a radius of 29 millimeters and point C' with a radius of 22 millimeters. And therefore, the B'G'H'A'C' shape formed will be the map we received to be divided on a scale of $\frac{1}{1000}$.

Description: It is easier to draw the lines on the map in the same direction by looking at the lines on the sketch.

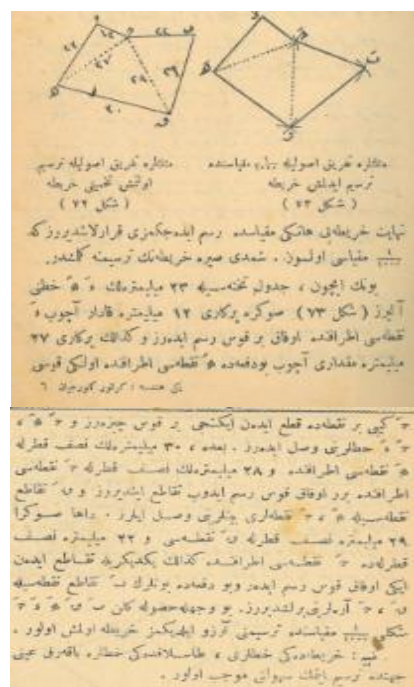


Figure 13. Example of compass context of the object theme (Kömürçiyân, 1925, pp. 81, 82)

DISCUSSION AND CONCLUSION

In this section, discussions, conclusions and suggestions related to the findings of the association skills in Kirkor Kömürçiyân's *Yeni Hesâb* and *Yeni Hendese* books will be presented.

1. Discussion and conclusion according to the associations between concepts

Different learning areas ($f=92$) are more integrated in the *Yeni Hesâb*. These relationships were achieved by combining content such as addition, subtraction, multiplication, division, fractions, the concept of money, the concept of time and units of measurement from the topics of numbers and operations in the exercises. The same learning areas were often found between numbers and operations ($f=60$). Although sequential numbers were not included as a topic, they were mentioned in the content of addition, subtraction, multiplication and division operations as well as in the concept of decimals in order to show the relationships between numbers. After answering many questions about odd and even numbers, multiplication by 2 and 3 was mentioned again when explaining multiplication by 2 and 3, and double was associated with two. Objects such as shoes, socks, etc. were also used in the question content and again the relationship between number operations and measurement was tried to be established.

Since the *Yeni Hendese* book is a geometry book, number operations, algebra and computing were not included in its content, but computing was never encountered in either book, while number operations and algebra from the *Yeni Hendese* book were used in the geometry content. One of the reasons for this may be that the *Yeni Hendese* book is suitable for the level of secondary school books according to the period in which it was taught. In terms of relationships between different learning domains, the relationship between geometry-measurement and number operations was observed most often ($f=63$, 33%). These relationships were mostly realised through the use of number operations learning domains such as four operations, decimal notation, fractions in the content of the geometry-measurement learning domain subjects.

In Dilegelen's (2018) study, one of the findings that relationships between concepts in data processing were never encountered. Computing is not included as a topic in the *Yeni Hesâb* book. Interconceptual associations were found to be one of the most common types of associations in recent studies (Tartan, 2023; Ünal, 2023) as in this study. In Sıcak's (2022) study, it was mentioned that the most common relationship after real life associations was between concepts.

2. Discussion and conclusions based on the association status between different representations of concepts.

Different representations of concepts are the associations that are included more than all other associations ($f=318$). In the *Yeni Hesâb*, there are fewer relations between different representations ($f=95$) than in the other book. As the *Yeni Hendese* is a geometry book, the use of models from different representations in graphs and tables is quite high ($f=107$). While the *Yeni Hesâb* book makes more use of concrete objects ($f=79$), the *Yeni Hendese* book focuses on modelling.

Dilegelen (2018) mentioned that the relationships between different representations of the concept are less common than other association skills. Coşkun (2013) came to the same conclusion in his study, stating that different representations were used

less. İncikabı and Biber (2018) found that the most multiple representations in secondary school textbooks were algebraic, verbal and model, and algebraic, verbal, model and explicit representations. In the present study, algebraic representations were found only in *Yeni Hendese* geometry textbooks, and it can be said that similar results were obtained in terms of the fact that symbolic, model and verbal multiple representations were included more. Şaşkan (2023) mentioned in his study that the symbolic expressions were more intensive in the textbooks used in 1941 and 1951. In this study, it can be said that symbolic representations were more in the *Yeni Hesâb* textbook and symbolic expressions were used in the content of fractions in the *Yeni Hesâb* textbook.

3. Discussion and conclusion according to interdisciplinary associations

When all associations were analysed, it was found that *Yeni Hesâb* and *Yeni Hendese* book contained at least interdisciplinary associations ($f=46$). In both books, these disciplines were life sciences, natural sciences and religious culture. In the *Yeni Hesâb* book, there are quite a few answers related to time measurement ($f=22$, 3%). The *Yeni Hendese*, on the other hand, includes geographical operations ($f=11$, 6%) and both of these situations are related to the Life Science discipline. Another discipline that attracts attention in the *Yeni Hesâb* is Religious Culture and Moral Knowledge. Moral elements of this content such as reading the Qur'an, buying a Qur'an book and giving alms were used in the practice questions.

In relation to this study, researchers such as Dilegen (2018), Sıcak (2022), and Ünal (2023) stated that they found the least understanding of interdisciplinary relationships in their studies. Özgen (2018) investigated high school students' views on the use of everyday life and different disciplines in his study and found that students' understanding of relations within mathematics was high, but their understanding of relations with different disciplines was low. Özgen (2019) worked with pre-service mathematics and science teachers, investigating their ability to plan activities associated with different disciplines. He found that the views of different disciplines remained limited in the activities used by pre-service teachers.

4. Discussion and conclusion according to the situations of association with real life

Associations with real life were found more often ($f=210$) in the *Yeni Hesâb* book than in the *Yeni Hendese* book. In both books, associations with real life were found mostly in the content of classical problems ($f=151$). In their studies, Sıcak (2022), Tartan (2023), Ünal (2023) mentioned that real life elements were found more often than other relationship situations. In this study, real-life elements are among the third most frequent findings.

Yeni Hesâb gave a small number of simple analogies ($f=19$). These analogies were found when explaining the concept of even, odd, half, whole, quarter, relationships between fractions and decimal notation. In the content of both books, the examination of real data, the discussion of mathematics in society and the mathematical modelling of real events did not appear at all. Bingölbali and Özđiner (2022), when analysing the activities in the textbooks in their study, mentioned that daily life skills were most frequent in the 2nd grade of primary school and least frequent in the 4th grade of primary school. In secondary school, real-life situations were most frequent in 6th grade books and least frequent in 8th grade books.

Taştepe (2022) analysed the everyday life relations in the problem content of pre-service mathematics teachers. They found that real-life relations were mostly used in classical problems, as in this study, but contexts such as cooking, architecture, and salary were used instead of real-life objects. In a joint study, Yekrek and Özgeldi (2019) examined real-life associations in introductory activities in secondary school mathematics textbooks and found that most associations were found in the content of classical problems. At the same time, they mentioned that real data and simple analogies were found to a lesser extent. The same situation was observed in the *Yeni Hesâb* book. Coşkun's (2013) study, which is one of the studies that found that more associations with real life were made at the primary school level, was supported by this study.

In Lee's (2012) study, participants generally reported that the money and time contexts were frequently used among the real life elements, but unlike this study, they reported that the food context was the least frequently used. It can be said that Baki et al. (2009) came to a different conclusion from the other studies in their study, stating that real life association is important but rarely encountered. There are other studies that support the study of Baki et al. (2009) (Açıkyıldız, 2013; Duran & Kaplan, 2016; Vinner 1992).

RECOMMENDATIONS

The books used in the study were written in 1925 and were transliterated and analysed according to association skills, which had not been seen before in the history of education. The extensive use of associative skills gives positive feedback about the understanding of the period. There are many of these books used in the first periods of the Republic, but in order to analyse the content, it is necessary to make them readable in today's Turkish. With this transliteration, other different books can be analysed in the same way and information about the educational understanding of the period can be obtained.

Similarities and differences between the examples and exercises used in today's textbooks and test books and those used in 1925 can be identified and their effects on students analysed. Applications included in the *Yeni Hesâb* and *Yeni Hendese* books but not used today can be used in the relevant classes in public schools with a pre- and post-test with experimental and control groups to see if there is a positive effect.

The sources of K  m  rciyan or other authors of the late Ottoman period whose names begin with ‘‘Yeni (New)’’ can be transcribed and analysed, and studies can be conducted on the educational understanding of the period. Other books by K  rk  r K  m  rciyan can be evaluated in the context of associative skills and a study can be made of K  m  rciyan's understanding of mathematics.

In the 1925 textbooks, other skills emphasised in mathematics education (problem solving, critical thinking, etc.) can be examined.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, author-ship, and/or publication of this article.

Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

REFERENCES

- A  kayıldız, G. (2013). *Matematik   ğretmeni adaylarının t  rev kavramını anlamaları ve yaptıkları hatalar* [Unpublished master thesis]. Karadeniz Technical University.
- Arabacı, E. (2018). *Salih Zeki'nin "Hisab Dersleri" eserinde hesaplamaya y  nelik kullanılan y  ntem ve tekniklerin incelenerek g  n  m  z matematik m  fredatıyla kar  ıla  tırılması* [Unpublished master thesis]. Marmara University.
- Aydemir, N. A. (2024). *H  sn   Hamid Sayman'ın Yeni Us  l Hendese kitabı ve deęerlendirilmesi* [Unpublished master thesis]. Kastamonu University.
- Ball, D. L., Hill, H., and Bass, H. (2005). Knowing mathematics forteaching: Who knows mathematics well enough to teach third grade, and how can we decide? *American Educator*, 29(1), 14-46.
- Baki, A.,   atlıoęlu, H., Co  tu, S. and Birgin, O. (2009). Conceptions of high school students about mathematical connections to the real-life. *Procedia Social and Behavioral Sciences*, 1(1), 1402-1407.
- Ba  kan,   . and   ay, A. M. (2019). Tanzimat d  nemi Osmanlı eęitim sistemi, *The Journal of International Social Research*, 12(64), 176-186.
- Bing  lbali, E. and Co  kun, M. (2016). İli  kilendirme becerisinin matematik   ğretiminde kullanımının geli  tirilmesi i  in kavramsal   er  ve   nerisi. *Education and Science*, 41(183), 233-249.
- Bing  lbali, E. and   zdiner, M. (2022). İlkokul ve ortaokul matematik ders kitabı etkinliklerinin ger  ek hayatla ili  kilendirme a  ısından incelenmesi, *Afyon Kocatepe University Journal of Social Sciences*, 24(1), 45-63.
- Co  kun, M. (2013). *Matematik Derslerinde İli  kilendirmeye Ne   l  de Yer Verilmektedir? Sınıf İ  i Uygulamalardan   rnekler* [Unpublished master thesis]. Gaziantep University.
- Ceylan, S. (2010). *"Nihayetu'l Elbab" adlı eserde d  rt i  lem ve kesir kavramları   ğretiminin deęerlendirilmesi ve zihinden hesaba dair bir uygulama*, [Unpublished master thesis]. Marmara University.
- Ceylan, S. (2017). *Enderun Mektebi'ndeki matematik   ğretiminin Mift  h  'l-His  b ı  ıęında incelenmesi ve   rnek uygulamalarla deęerlendirilmesi*, [Unpublished doctoral thesis]. Marmara University.
- Dilegelen, Y. (2018). *5. sınıf matematik ders kitaplarının ili  kilendirme becerisi a  ısından incelenmesi* [Unpublished master thesis]. Gaziantep University.
- Demirhan   avu  oęlu, H. M. (2021, Ekim 2-9). *T  rkiye'de Osmanlı matematik tarihi'ne y  nelik yazılan tezler i  in metodolojik a  ıdan genel bir bakı  * [Tam Metin], II. Uluslararası Fuat Sezgin İ  lam Bilim Tarihi Sempozyumu, İstanbul, T  rkiye.
- Dosay G  kdoęan, M., K  kc  , A., Demirhan   avu  oęlu, H. M. and Yılmaz Erten, S. (2024). *Eski harfli t  rk  e matematik biyo-bibliyografyası (1900-1023)*. Nobel Yayıncılık.
- Duran M. and Kaplan A. (2016). Lise matematik   ğretmenlerinin t  revi tanıma ve t  rev s  rekli  lik ili  kisine y  nelik pedagojik alan bilgileri. *Erzincan University Journal of Education Faculty*, 18, 795–831.
- Duru, Z. (2017). *Kerim Erim'in matematik   alı  malarının bilim tarihi a  ısından deęerlendirilmesi* [Unpublished master thesis]. İstanbul University.
- Ece, T. (2021). *Matematik eęitiminde ili  kilendirme becerisi: sistematik derleme   alı  ması* [Unpublished master thesis]. Necmettin Erbakan University.
- Eli, J. A, Mohr-Schroeder, M. J., and Lee, C. W. (2013). Mathematical connections and their relationship to mathematics knowledge for teaching geometry. *School Science and Mathematics*, 113(3), 120–134.
- G  r  n, V. (1948). *Profes  r K  rk  r K  m  rc  yan j  bilesi*, İstanbul Y  ksek Ekonomi ve Ticaret Okulu Mezunları Cemiyeti.
- G  vemli, O., and Aytulun, A. (2012). *T  rkiye'de muhasebe mesleęinin geli  mesi ve ilk meslek   rg  tlenmesi*. T  rkiye Muhasebe Uzmanları Derneęi.
- İncikabı, S., and Biber, A.   . (2018). Ortaokul matematik ders kitaplarında yer verilen temsiller arası ili  kilendirmeler. *Kastamonu Education Journal*, 26(3), 729-740.

- Johansen, D.H. (1991). Objectivism versus constructivism: Do we need a new philosophical paradigm? *Educational Technology Research and Development*, 39 (3), 5-14.
- Karataş, Ş., Yücel, M. and Adiloğlu, G. (2018). Muhasebe eğitime verilen doksan yıllık ömür: Kırkor Kömürçüyan. *Journal of Accounting Institute*, (16)71-80.
- Li, S. (2020). *A comparative study of directional connections in popular us and chinese high school mathematics textbook problems* [Unpublished Ph.D. Thesis]. Columbia University.
- MEB (2013). *Ortaokul matematik dersi (5,6,7 ve 8. sınıflar) öğretim programı*. Devlet Kitapları Müdürlüğü Basımevi.
- MEB. (2018). *İlköğretim matematik dersi 6-8. sınıflar öğretim programı ve kılavuzu*. Millî Eğitim Bakanlığı Talim Terbiye Kurulu Başkanlığı.
- Miles, M. B., and Huberman, A. M. (1994). *Qualitative data analysis: an expanded sourcebook*. Sage Publications.
- National Council of Teachers of Mathematics (NCTM). (2000). *Principles and standards for school mathematics*. The National Council of Teachers of Mathematics, Inc.
- Öksüz, A. (2019). *1900-1940 seneleri arasındaki ortaokul matematik ders kitaplarının günümüz matematik ders kitapları ile mukayesesi*, [Unpublished master thesis]. Necmettin Erbakan University.
- Özçelik, İ. (1993). *Tarih araştırmalarında yöntem ve teknikler*. Nobel Yayıncılık.
- Özdiner, M. (2021). *İlkokul ve ortaokul matematik ders kitaplarındaki etkinliklerin matematiksel ilişkilendirme becerisi açısından incelenmesi* [Unpublished master thesis]. Afyon Kocatepe University.
- Özgen, K. (2018). Lise öğrencilerinin matematiksel ilişkilendirmeye yönelik görüşlerinin incelenmesi. *Buca Faculty of Education Journal*, (45), 1–22.
- Sıcak, A. (2022). *Liselere Geçiş Sistemi (LGS) matematik soruları ile 8. sınıf matematik ders kitapları ünite değerlendirme sorularının “ilişkilendirme becerisi” çerçevesinde karşılaştırmalı incelenmesi* [Unpublished master thesis]. Gaziantep University.
- Singletary, L. M. (2012). *Mathematical connections made in practice: An examination of teachers’ belief and practices* [Unpublished Ph.D. Thesis]. University of Georgia.
- Şaşkan, M. (2013). *Kesir konusunun cumhuriyet sonrası dönem matematik ders kitaplarında çoklu temsiller açısından incelenmesi* [Unpublished master thesis]. Gaziantep Kocatepe University.
- Takıcak, M. (2016). *Salih Zeki’nin matematik felsefesi ve matematik eğitimi anlayışı* [Unpublished Ph.D. Thesis]. Ankara University.
- Tanju, B. (2020). *Matematik öğretmen adaylarının temsil ve ilişkilendirme becerilerinin matematiksel modelleme sürecinde incelenmesi* [Unpublished master thesis]. Hacettepe University.
- Tartan, Y. Ş. (2023). *Ortaokul matematik ders kitaplarındaki etkinliklerin matematiksel ilişkilendirme becerisi açısından incelenmesi* [Unpublished master thesis]. Selçuk University.
- Taştepe, M. (2022). Matematiksel kavramların günlük hayat ile ilişkilendirilmesi: sözel problem bağlamı. *Journal of Research in Education and Teaching*, 11(2), 18–29.
- Ünal, K. H. (2023). *Ortaokul matematik ders kitaplarının ilişkilendirme becerisi açısından incelenmesi* [Unpublished master thesis]. Pamukkale University.
- Vinner S, (1992). The function concept as a prototype for problems in mathematics learning, in g harel and e dubinsky. E. Dubinsky, G. Harel (Ed.), *The Concept of a Function: Aspects of Epistemology and Pedagogy* in, (pp. 195–213), Mathematical Association of America.
- Yavuz Mumcu, H. (2018). Matematiksel ilişkilendirme becerisinin kuramsal boyutta incelenmesi: türev kavramı örneği. *Türk Bilgisayar ve Matematik Eğitim Dergisi*, 9(2), 211-248.
- Yaprak, E. (2015). *Investigating the foundations of turkish elementary mathematics education through an analysis of a late ottoman textbook*, [Unpublished master thesis]. İhsan Doğramacı Bilkent University.
- Yekrek, E., and Özgeldi, M. (2019). Ortaokul matematik ders kitaplarının konuya giriş bölümlerinin gerçek hayat ilişki ve bağlamları kapsamında incelenmesi. *Afyon Kocatepe University Journal of Social Sciences*, 24 (1) 45-65.
- Yel, N. (2010). *Hulasat Al-Hisâb adlı eserin geometri öğretimi açısından incelenmesi ve yeni müfredat ile karşılaştırılması* [Unpublished master thesis]. Marmara University.
- Yer, O. (2021). *Kırkor Kömürçüyan’ın İlm-i Hendese adlı eserinin günümüz türkçesine aktarılması ve değerlendirilmesi* [Unpublished master thesis]. Muğla Sıtkı Koçman University.



| Research Article / Araştırma Makalesi |

A Systematic Research on Exploring How Differentiated Instruction Can Provide a Remedy to Facilitate and Promote Learning

Öğrenmeyi Kolaylaştırmak ve Teşvik Etmek İçin Farklılaştırılmış Eğitimin Bir Çözüm Sunabileceğini Keşfetmeye Yönelik Sistematik Bir Araştırma

Şenol Deniz¹

Keywords

- 1.Educational Content in Differentiated Instruction
- 2.A Remedy to Enhance Learning
- 3.A Strategy to Facilitate Learning and Its Outcomes
- 4.Readiness Levels
- 5.Process Differentiation

Anahtar Kelimeler

- 1.Farklılaştırılmış Eğitim İçeriği
- 2.Öğrenmeyi Geliştirmek İçin Bir Çözüm
- 3.Öğrenmeyi ve Sonuçlarını İyileştirmek İçin Bir Strateji
- 4.Hazırlanmışlık Düzeyi
- 5.Süreç Farklılaştırması

Received/Başvuru Tarihi
30.12.2024

Accepted / Kabul Tarihi
25.07.2025

Abstract

Purpose: This study investigates the foundational theoretical paradigms, methodologies, techniques, and characteristics of differentiated instruction, aiming to systematically evaluate its effectiveness in enhancing educational content and facilitating the learning process. It seeks to uncover how differentiation strategies contribute to student success and engagement by addressing diverse learning needs and preferences.

Design/Methodology/Approach: The research employs a descriptive study method to analyse differentiated instruction. It identifies key factors that influence its efficacy, focusing on instructional methods, process differentiation, and the consideration of individual readiness levels. The study draws on theoretical and practical insights to explore how these components work in concert to support student learning.

Findings: The findings reveal that differentiated instruction significantly enhances learning by aligning educational content with students' individual learning styles and preferences. By offering a variety of instructional methods, flexible teaching strategies, and tailored feedback, differentiated instruction fosters greater student motivation, engagement, and success. The study highlights the importance of addressing individual readiness levels and providing autonomy in learning choices to maximize educational outcomes.

Highlights: Differentiated instruction improves engagement by accommodating diverse learning modalities (e.g., visual, auditory, kinaesthetic, and textual). Tailored lesson plans and materials designed to match individual characteristics and readiness levels are crucial. Flexible teaching methods and varied content options enable students to make autonomous learning choices. Differentiation strategies address the unique experiences, prior knowledge, interests, and profiles of learners, enhancing overall motivation and success.

Öz

Çalışmanın amacı: Bu çalışma, farklılaştırılmış eğitimin temel teorik paradigmlarını, yöntemlerini, tekniklerini ve özelliklerini araştırarak, eğitim içeriğini geliştirme ve öğrenme sürecini kolaylaştırma konusundaki etkinliğini sistematik bir şekilde değerlendirmeyi amaçlamaktadır. Çalışma, farklılaştırma stratejilerinin, çeşitli öğrenme ihtiyaçlarını ve tercihlerini ele alarak öğrenci başarısı ve katılımına nasıl katkı sağladığını ortaya çıkarmayı hedeflemektedir.

Materyal ve Yöntem: Araştırma, farklılaştırılmış eğitimi analiz etmek için betimsel bir çalışma yöntemi kullanmaktadır. Çalışma, etkinliğini etkileyen temel faktörleri belirleyerek öğretim yöntemlerine, süreç farklılaştırmasına ve bireysel hazırlanmışlık düzeylerinin dikkate alınmasına odaklanmaktadır. Bu bileşenlerin öğrenci öğrenimini desteklemek için nasıl bir arada çalıştığını incelemek amacıyla teorik ve pratik içgörülerden yararlanılmaktadır.

Bulgular: Bulgular, farklılaştırılmış eğitimin, eğitim içeriğini öğrencilerin bireysel öğrenme stilleri ve tercihleriyle uyumlu hale getirerek öğrenmeyi önemli ölçüde geliştirdiğini ortaya koymaktadır. Çeşitli öğretim yöntemleri, esnek öğretim stratejileri ve kişiye özel geri bildirimler sunarak, farklılaştırılmış eğitim, öğrencilerin motivasyonunu, katılımını ve başarısını artırmaktadır. Çalışma, bireysel hazırlanmışlık düzeylerinin ele alınmasının ve öğrencilere öğrenme seçimlerinde özerklik sağlanmasının, eğitimsel sonuçları en üst düzeye çıkarmadaki önemini vurgulamaktadır.

Önemli Vurgular: Farklılaştırılmış eğitim, görsel, işitsel, kinestetik ve metinsel gibi çeşitli öğrenme biçimlerine uyum sağlayarak katılımı artırır. Bireysel özelliklere ve hazırlanmışlık düzeylerine uygun şekilde tasarlanmış ders planları ve materyaller hayati önem taşır. Esnek öğretim yöntemleri ve çeşitli içerik seçenekleri, öğrencilerin öğrenme seçimlerinde özerklik kazanmalarını sağlar. Farklılaştırma stratejileri, öğrencilerin benzersiz deneyimlerini, ön bilgilerini, ilgi alanlarını ve profillerini ele alarak genel motivasyon ve başarıyı artırır.

¹ Corresponding Author, Ankara University, School of Foreign Languages, Department of English, Ankara, TÜRKİYE; <https://orcid.org/0000-0003-2553-1070>

INTRODUCTION

In today's world, individuals differ significantly in their nature, life circumstances, and educational backgrounds. As a result, offering learning opportunities tailored to each person's unique abilities and needs can enhance their academic success. Although its widespread application is relatively recent, differentiated instruction has gained significant recognition in education. This approach promotes inclusive and responsive learning environments by addressing learners' diverse needs. Unlike traditional education, which relies on a fixed curriculum, standardized materials, and uniform teaching practices, differentiated instruction seeks to move beyond these limitations. It aims to create a more effective learning process by adapting to students' varied needs. Taşpınar (2012) defines education as a lifelong process of fostering positive and lasting behavioural change. Teaching, as a core element of education, involves planned, executed, and evaluated activities designed to ensure meaningful learning, often through structured lessons. These activities are guided by different theories, strategies, and methods. Within this context, differentiated instruction stands out as an approach that centres on individual needs, seeking to maximize each student's potential for success.

There are numerous definitions of differentiated instruction in the literature. Hall, Vue, Strangman, and Meyer (2004) define it as the practice of recognizing and responding to students' diverse backgrounds, readiness levels, languages, learning preferences, and interests. According to Heacox (2002), it involves modifying the pace, complexity, or type of instruction to meet individual learning needs, thereby supporting student progress based on what they already know and what they need to learn. This approach allows learners to demonstrate understanding through their strengths, interests, and preferred modes of learning. Tomlinson (1999) describes differentiation as the design of varied learning experiences through which students engage with content in multiple ways. It includes organizing tasks and processes that foster meaningful learning and offering students options in how they express their understanding. Differentiated instruction, as a teaching philosophy, enables educators to tailor lesson plans to better meet students' needs and achieve targeted learning outcomes. Drawing from these definitions, it can be described as an approach that adjusts the type and complexity of content based on students' prior knowledge, readiness, interests, and learning profiles. It promotes student choice and fosters a positive, inclusive environment that values diverse learning products. Rooted in the belief that all students can learn, this method equips teachers with strategies aligned to learners' levels, subject matter, and individual needs. Educators who implement this approach understand how their students learn best and adapt instruction accordingly.

Demir (2021) emphasizes that differentiated instruction addresses individual differences among students but should not be mistaken for individualized instruction. While both approaches support personalized learning, differentiated instruction also promotes social skills such as communication, collaboration, and teamwork. Its goal is to reach common learning objectives through varied methods, rather than focusing on individual deficiencies. In this approach, students are placed in heterogeneous, flexible groups that can be reorganized based on interests and readiness. Unlike individualized instruction, which may apply multiple methods simultaneously, differentiated instruction typically involves selecting a single, most suitable method for the entire class. Teachers are expected to plan lessons in advance, selecting methods aligned with students' prior knowledge, interests, and readiness levels. Students should be given opportunities to make choices, and upon completing their tasks, individuals or groups are encouraged to present their work to the class. Evaluation should take place before, during, and after instruction to inform and adapt the teaching process.

Parsons, Dodman, and Burrowbridge (2013) define differentiated instruction as the adaptation of content, process, and product based on students' readiness, interests, and learning styles. Three key techniques support its implementation: layered instruction, centres, and stations. In layered instruction, all students pursue the same learning goals, while teachers adjust the content, process, and product flexibly. According to Tomlinson (2005), centres are designated classroom areas equipped with materials for specific learning purposes, where students work at their own pace to explore, create, and deepen understanding. Stations, in contrast, are separate task-based areas where students engage in different activities simultaneously. Tasks may vary in complexity and are tailored to students' readiness levels or learning styles, using diverse materials to support differentiated learning.

Purpose of the Research and Sub-Problems

The objective of this comprehensive research article is to explore the foundational paradigms, methodologies, techniques, and characteristics of differentiated instruction, systematically assessing its effectiveness in enhancing educational content and promoting the learning process. Utilizing a descriptive study method, the research identifies key factors contributing to student success and engagement, such as diverse instructional methods, process differentiation, and addressing individual readiness levels. The study involves an extensive review of theoretical and practical insights, analysing previously published works including articles, books, theses, and conference papers to construct a comprehensive understanding of how differentiated instruction caters to diverse learner needs and preferences (Webster & Watson, 2002). By examining the development of differentiated teaching strategies, the article offers a framework for predicting advancements in instructional techniques while emphasizing the importance of tailored lesson plans, flexible teaching methods, and varied content that align with individual learning styles and readiness levels. These findings underscore the transformative potential of differentiated instruction in fostering student motivation, engagement, and overall educational success. The significance of this study lies in its thorough examination of the impact of differentiated instruction on education and its provision of strategies to enhance student success and engagement. Tailoring content and methods to align with each student's unique learning style, needs, and readiness levels is crucial for

optimizing their potential. The research demonstrates how diverse instructional methods, and personalized feedback can boost student motivation, while also making the teaching process more effective and inclusive (Deniz, 2024). By offering a solid foundation for educators to develop more nuanced and effective teaching strategies that account for student diversity, this study underscores the value of an individualized approach in education. Moreover, it holds substantial importance in addressing gaps in the existing literature on differentiated instruction, thereby illuminating this area of study. Consequently, this article serves as a valuable resource for advancing student success and improving the overall learning experience, contributing to the creation of more equitable and effective educational environments.

Within the framework of this research paper, the answers to the following research questions are sought:

1. How do differentiated instructional methods affect students' perception of course content, making it more interesting and meaningful?
2. What are the impacts of using course materials tailored to students' individual learning styles and readiness levels on their motivation and engagement?

A REVIEW OF THE LITERATURE

The Historical Overview of Differentiated Instruction

Hall (2003) highlights that differentiated instruction entails adapting various aspects of the teaching process to accommodate individual learner differences. Rather than applying a uniform teaching style, content, or product to all students, it offers multiple pathways suited to students' needs, abilities, and learning profiles. This requires teachers to remain flexible in pacing and delivery, shifting the focus from conformity to curriculum towards curriculum that adapts to learners. Heacox (2002) and Tomlinson (2001) similarly underscore differentiation as a learner-centred approach that adjusts instruction according to readiness levels, interests, and learning preferences. Chapman and King (2003) identify three essential components of this approach: content, process, and product—all modified to suit the varying levels and styles within a classroom. Aşıroğlu (2016) expands this understanding by emphasizing the role of student-specific variables—such as prior knowledge, reading skills, and conceptual understanding—in shaping differentiated instruction. It promotes inclusive classroom practices by creating learning environments tailored to diverse academic profiles, thereby enhancing individual student success and engagement. Avcı and Beler (2016) define differentiated instruction as a pedagogical model that integrates student-centred principles and contemporary educational strategies. They argue that learners' unique cognitive, emotional, and social traits necessitate instructional planning that acknowledges these variations to support the development of higher-order thinking skills. Tomlinson (2017) further grounds differentiated instruction in brain-based learning, theories of multiple intelligences, and individual learning styles, framing it as an integrated response to the diverse demands of modern classrooms. It seeks not only to increase the likelihood of academic achievement but also to foster each student's personal development through targeted learning experiences and varied instructional methods (Heacox, 2002).

Overall, the literature converges on the idea that differentiated instruction is not merely a collection of strategies but a dynamic teaching philosophy. It integrates evidence-based insights from cognitive science and educational psychology to design responsive learning environments that maximize each learner's potential.

The Characteristics of Differentiated Instruction

Tomlinson (2017) contrasts individualized instruction of the 1970s with modern differentiated instruction, highlighting a shift from isolated, one-on-one methods to inclusive, whole-class strategies that cater to varying readiness levels while preserving group cohesion. Rather than dividing students into homogeneous groups, differentiated instruction emphasizes heterogeneous, flexible groupings that foster collaboration and target individual growth beyond current competencies. Within this framework, instructional content, process, and product are adapted according to students' readiness, interests, and learning profiles. Readiness refers to prior knowledge and skill levels, interest to students' engagement with specific topics, and learning profile to preferred modes of learning. These dimensions guide the design of differentiated learning experiences aimed at maximizing each student's potential.

Assessment is central to this process, offering insight into students' needs and progress. As Tillman (2020) notes, pre-assessment functions diagnostically to determine readiness and learner characteristics before instruction begins. Process assessment occurs during instruction to monitor learning, offer feedback, and adjust teaching in real time, using tools like interviews, journals, and surveys. Feedback gathered here is vital, as its absence may hinder progress. Final assessment, administered at the end of instruction, evaluates not only the outcome but also the quality of the learning process. It provides space for varied student outputs aligned with learning styles and incorporates self- and peer-assessment to build critical thinking and metacognitive skills.

The Theoretical Foundations Underpinning Differentiated Instruction

The theoretical foundations of differentiated instruction are deeply rooted in constructivist learning, drawing on key frameworks such as Vygotsky's Zone of Proximal Development (ZPD), Gardner's Multiple Intelligences, brain-based learning, thinking and learning styles, and cooperative learning. Gömleksiz and Eladı (2011) emphasize that constructivism positions learners as active participants responsible for constructing meaning by linking prior knowledge to new experiences. Instruction,

therefore, must prioritize experiential, student-centred activities that stimulate cognitive engagement, with teachers acting as guides in flexible learning environments that encourage interaction and autonomy. Vygotsky's ZPD, as discussed by Baysen and Silman (2012), highlights the significance of tasks that learners can accomplish with guided support, underscoring the role of social interaction in cognitive development. Karadağ (2010) further notes that meaningful peer or mentor collaboration enhances this developmental zone. Differentiated instruction leverages flexible, heterogeneous grouping to activate students' potential within their ZPD, encouraging collaboration and mutual scaffolding. Gardner's theory of multiple intelligences (Davis et al., 2011) proposes that learners possess diverse intellectual strengths—ranging from verbal-linguistic to bodily-kinaesthetic and naturalist intelligences. Aligning instructional strategies with these intelligences fosters engagement and promotes achievement. Differentiated instruction reflects this view by tailoring tasks to both support and challenge multiple intelligence domains. Deniz and Alici (2024) posit that brain-based learning further supports this approach, suggesting that autonomy, choice, and cognitively stimulating tasks boost motivation and reduce stress. Differentiated instruction incorporates these principles by allowing student choice and designing tasks that push cognitive boundaries while maintaining relevance and interest. Tomlinson (2017) emphasizes the importance of recognizing learning and thinking styles when shaping instructional strategies. Identifying the methods and materials that resonate with learners helps foster metacognitive awareness and prepares students for independent learning.

Finally, cooperative learning, as defined by Zorlu (2020), provides a social foundation for differentiated instruction. Working in heterogeneous groups towards shared goals fosters academic and social growth. It nurtures collaboration, accountability, and communication skills, essential for 21st-century learning environments.

Planning and Implementing Differentiated Instruction

Tomlinson (2017) calls attention to the importance of several features that teachers should pay attention to when implementing differentiated instruction. These features are presented below. First, the teacher should have a clear idea about differentiation.

1. Students and parents should be informed and prepared in advance for differentiated instruction.
2. More student-centred learning and appropriate classroom management should be adopted.
3. Differentiated instruction should be applied at rates and speeds that both the student and the teacher feel comfortable with.
4. Plans should be made together with other colleagues interested in differentiated instruction.

The Differentiated Elements in Differentiated Instruction

Zoraloğlu and Şahin (2022) outline four core components of differentiated instruction—content, process, product, and environment—each of which can be adapted to meet diverse student needs. Content refers to what is taught and focuses on essential learning outcomes. In differentiated instruction, content is not uniformly delivered; instead, it is tiered based on students' readiness levels, allowing varying degrees of complexity while maintaining curricular integrity. This ensures that foundational knowledge is accessible to all learners without compromising academic rigor. Process addresses how learning occurs. Differentiation at this stage involves selecting and applying varied instructional strategies and assessment techniques that align with students' learning profiles and interests. Formative assessment plays a pivotal role here, guiding instruction and enabling real-time adjustments to foster student engagement and understanding. Product reflects what students produce to demonstrate learning. In differentiated instruction, students are given choices in how they express their understanding—through written, visual, oral, or project-based outputs—thus promoting autonomy and catering to individual strengths. These products also serve as indicators of students' progress and readiness for subsequent learning stages. Environment encompasses both the physical and psychological learning contexts. Physically, this may involve rearranging classroom space or utilizing alternative learning settings to support different activities. Psychologically, it involves cultivating a supportive atmosphere that encourages communication, collaboration, and a positive attitude toward learning. Deniz and Alici (2024) emphasise the fact that a well-structured psychological environment not only supports socialization but also enhances students' intrinsic motivation and sense of belonging. Ultimately, differentiated instruction seeks to align the content, process, and product with students' readiness, interests, and learning styles. This alignment fosters equitable access to learning opportunities and promotes deeper engagement. By providing flexible options within structured goals, teachers can challenge all learners appropriately and create inclusive environments where every student is positioned for growth.

The Assessment Techniques Employed in Differentiated Instruction

Gregory and Chapman (2020) emphasize the importance of continuous assessment in differentiated instruction, which involves assessing students at multiple stages—before, during, and after instruction. This ongoing evaluation enables teachers to monitor student progress and provide timely feedback, ensuring that learning objectives are met. Pre-assessment, conducted before the lesson, helps determine students' prior knowledge, interests, and learning preferences. These informal assessments, which may include techniques such as square division, surveys, or wall writing, provide valuable insight into students' readiness and guide

instructional planning. Formative assessment occurs during the lesson and serves to gauge students' understanding of the material in real-time. It allows teachers to identify misconceptions, offer immediate feedback, and adjust instruction accordingly. Techniques such as the thumb, fist, or speedometer reading offer quick and informal ways to assess students' learning progress. Post-assessment takes place at the conclusion of the lesson and is used to evaluate student achievement and overall comprehension. Techniques like spiral reviews or reflective exercises (e.g., turn reflection or drawing pictures) offer opportunities for students to demonstrate their understanding and for teachers to gauge the effectiveness of the instruction. Additionally, authentic assessments, such as projects or portfolio studies, provide students with opportunities to engage in real-world problem-solving. These assessments encourage creativity and support deeper, more meaningful learning by allowing students to apply knowledge in practical contexts.

The Methods Employed in Differentiated Instruction

Various methods and techniques are utilized in differentiated instruction, including the following: layered instruction, the station method, centres method, agenda method, learning contracts, entry points method, literature circles, RAFT (Role, Audience, Format, Topic) method, story-based learning, and numbered heads together, among others. However, in this research study, all of these methods employed in differentiated instruction are not examined due to the limitation of the study to only three themes derived from the data analysis. The station method, centres method, entry points method are investigated in detail based on the thematic codes of the study.

METHOD/MATERIALS

In this research which explores the groundbreaking importance of differentiated instruction to discover whether it facilitates and promotes learning or not, the researcher employs a descriptive research method to address the research questions central to the article. In this context, as articulated by Webster and Watson (2002), a review of the literature refers to the critical systematic examination of the existing written materials and scholarly works to gather conclusive and compelling data. Therefore, a review of the literature is employed in this research through the documentation analysis technique. To systematically collect data, a comprehensive literature search was conducted using academic databases such as ERIC, Scopus, Web of Science, and Google Scholar. The keywords used in the search included "differentiated instruction," "learning styles," "inclusive pedagogy," "student engagement," and "instructional strategies." The search focused on peer-reviewed articles published between 2000 and 2024. The inclusion criteria consisted of empirical and conceptual studies focusing on differentiated instruction at primary, secondary, or higher education levels, published in English, and accessible in full text. Exclusion criteria involved studies unrelated to formal education contexts, non-peer-reviewed articles, and studies that did not offer insight into learning outcomes or instructional practices. In this regard, following the literature review with the document analysis technique, the researcher identifies and documents several themes that emerge from the data collected from existing studies on differentiated instruction, aimed at enhancing and optimizing learning. The essential data, which constitute the core of the research, are analysed qualitatively. The data from the existing body of research in the literature are analysed using thematic analysis. The emphasis has been placed on inductive analysis, which is derived from an iterative examination and comparison of raw data. Through this rigorous process, themes have emerged from the data (Creswell, 2007; Miles and Huberman, 1984).

Considering the data collected through documentation analysis, the steps of thematic analysis, as outlined by Braun and Clarke (2006), are followed, and a systematic approach is adopted for processing qualitative data through coding. Initially, an extensive review of the literature through documentation analysis technique was conducted to gather data, with an extensive examination of the literature meticulously annotated by highlighting several pivotal concepts. The entire dataset is subsequently subjected to a rigorous and methodical coding process. Phrases reflecting specific perspectives are utilized during this phase. For example, recurring expressions such as "student-centred learning," "multiple intelligences," and "adaptive teaching strategies" were noted as codes. Once the coding schema is established, the codes are systematically organized into overarching themes. To ensure the validity of these themes, their alignment with the initial codes is cross-examined. Representative excerpts were selected to demonstrate each theme, ensuring that the final analysis reflected the essence of the research findings (Braun & Clarke, 2006).

The following findings emerged from the data illustrate the following themes:

1. The Provision of Varied Instructional Methods and Diverse Learning Content as Catalysts for Enhancing Student Success and Engagement
2. The Pivotal Role of Process Differentiation in Tailoring Instruction to Varied Learning Modalities: Visual, Auditory, Kinaesthetic, and Textual
3. The Essentiality of Proportionate Attention to Individual Readiness Levels and Needs for Effective Differentiation

FINDINGS

1.Theme: Differentiated Instruction as Catalysts for Enhancing Student Success and Engagement

As it is mentioned, differentiated instruction has emerged as a crucial factor in fostering student engagement and enhancing their perception of course content. As outlined in the methods section, various approaches within differentiated instruction play a pivotal role in engaging students with diverse learning styles and needs. Specifically, the Station Method, Centres Method, RAFT method, story-based learning, and numbered heads together were identified as key techniques contributing to the success of differentiated learning experiences.

The Station Method

Kılınç and Sözer (2023) emphasize that the Station Method facilitates enriched learning experiences by organizing the classroom into distinct learning stations. At each station, students engage with various materials tailored to the course objectives and individual learning needs. The design of tasks at each station is carefully aligned with students' readiness levels and learning speeds, ensuring that every student works at an appropriate pace. Excerpts from the data reflect that students appreciated the flexibility of moving through stations based on their progress, stating, "I felt more in control of my learning. When I finished early, I could move ahead and challenge myself." This finding underscores the importance of student autonomy in fostering engagement, as the method allows students to take responsibility for their learning (Kılınç & Sözer, 2023). Moreover, the collaborative nature of the method promotes social interaction, contributing to the development of both content knowledge and soft skills.

The Centres Method

Tomlinson (2017) describes the Centres Method as a flexible approach, where students engage with the same content in different ways. The method includes learning centres and interest centres, which cater to different aspects of student interests and skills. Through interest-based learning, students are more likely to find the material engaging. Analysing the data, students reported higher levels of motivation when working in interest centres: "The topic was more exciting when I could explore it in my own way," a participant noted. This supports the theoretical framework of student-centred learning, which emphasizes the value of tailoring instruction to individual interests and needs (Tomlinson, 2017).

The RAFT (Role, Audience, Format, Topic) Method

The RAFT (Role, Audience, Format, Topic) method, as detailed by Demir (2021), empowers students to make choices based on their interests and competencies. This method promotes active participation and decision-making, which are critical to fostering engagement. Codes derived from the data, such as "empowerment," "choice," and "responsibility," indicate that students valued the autonomy provided by this approach. A student explained, "I liked being able to choose my role and audience—it made the assignment feel personal." This aligns with the research questions, particularly in terms of how differentiated instructional methods can make the content more meaningful and engaging.

2.Theme: The Pivotal Role of Process Differentiation in Tailoring Instruction to Varied Learning Modalities: Visual, Auditory, Kinaesthetic, and Textual

The second theme underscores the importance of differentiating the instructional process to address the diverse learning modalities of students, including visual, auditory, kinesthetic, and textual learners. The Entry Points Method is central to this theme, providing multiple pathways for students to engage with content based on their preferred learning styles.

The Entry Points Method

Gardner posits that, given the unique intelligence profiles and learning trajectories of each student, it is imperative for students to engage with the subject matter through the most fitting learning strategies. Gardner's (2021) Entry Points Method offers five distinct ways for students to engage with content: narrative, logical-quantitative, basic, aesthetic, and experiential. Patterns observed in the data show that students who engaged with the aesthetic and experiential entry points expressed a greater emotional connection to the material. For example, a student noted, "I understood the topic better through the hands-on activity, we connected the theory to real life." This reinforces the need for process differentiation that considers varied cognitive and sensory learning styles, which enhances engagement and content retention. The data suggest that offering students a choice of entry points significantly impacted their motivation to engage with course material (Gardner, 2021).

To facilitate this, Gardner proposes five distinct entry points, each catering to different aspects of learning:

1. Narrative Entry Point: Instruction begins with a narrative that introduces the subject or concept, setting the stage for exploration.
2. Logical-Quantitative Entry Point: This approach employs numerical representation or deductive reasoning to frame the subject matter.
3. Basic Entry Point: Focuses on examining fundamental terms and underlying philosophies that form the core of the subject.
4. Aesthetic Entry Point: Centres on the emotional and artistic dimensions of the concept being studied.
5. Experiential Entry Point: Emphasizes learning through direct experience, engagement, and hands-on activities.

The educator designs five distinct tasks corresponding to these entry points, ensuring alignment with the lesson's developmental objectives. Students select tasks based on their interests, abilities, or readiness and collaborate in groups to complete them. Subsequently, they present their work to other groups. When utilized as an introductory activity, the entry points method allows for a differentiated content delivery in the classroom, thereby tailoring the educational experience to individual student characteristics and fostering a flexible learning environment (Demir, 2021).

3.Theme: The Essentiality of Proportionate Attention to Individual Readiness Levels and Needs for Effective Differentiation

The third theme highlights the critical role of addressing students' individual readiness levels and needs in ensuring effective differentiation. The Multi-layered Teaching Method serves as a practical approach to aligning content, processes, and products with students' cognitive abilities and learning speeds.

The Multi-layered Teaching Method

The Multi-layered Teaching Method (Demir, 2021) focuses on tailoring instructional content to the varying readiness levels of students, ensuring that each student works at their appropriate level of challenge. Data excerpts support the claim that this method leads to better student outcomes, with one student stating, "The tasks were just right for me. Not too hard but challenging enough to keep me engaged." This method's effectiveness lies in its ability to cater to students' individual learning paces while maintaining high standards for all learners, ensuring that everyone can achieve the same learning outcomes. This approach demonstrates the importance of tiered learning tasks, which promote inclusivity while maintaining rigorous academic standards (Demir, 2021).

FINDINGS BASED ON THE RESEARCH QUESTIONS

1. **How do differentiated instructional methods affect students' perception of course content, making it more interesting and meaningful?**

The findings indicate that differentiated instructional methods, particularly those that allow students to choose the type of learning experience (e.g., through the RAFT or Centres Method), significantly enhance students' perceptions of course content. Students report that the ability to engage with content through personalized methods makes the material more meaningful and engaging. Data patterns also show that content tailored to individual learning styles (e.g., through the Entry Points Method) increases students' emotional connection to the material, making it more interesting.

2. **What are the impacts of using course materials tailored to students' individual learning styles and readiness levels on their motivation and engagement?**

The use of differentiated materials, particularly those aligned with students' learning styles (e.g., visual, auditory, kinesthetic) and readiness levels, has a profound impact on student motivation and engagement. Students expressed higher levels of intrinsic motivation and engagement when materials were tailored to their individual preferences, as evidenced by statements like, "I felt more motivated to learn when I could approach the content in my own way." The data suggests that differentiation not only meets students' diverse needs but also fosters a deeper, more personal connection to the learning process.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

The research article's findings reveal that differentiated instruction can be comprehensively defined as the strategic modification of content, process, product, and environment dimensions in alignment with students' interests, needs, readiness, and learning profiles. These insights address key questions central to the research: How do differentiated instructional methods affect students' perception of course content, making it more interesting and meaningful? and What are the impacts of using course materials tailored to students' individual learning styles and readiness levels on their motivation and engagement? The study not only provides answers to these queries but also offers actionable suggestions and practical classroom strategies. The theoretical underpinning of differentiated instruction prominently features the constructivist approach. This is evidenced by its

reliance on Vygotsky's concept of the proximal development zone, brain-based learning principles, cooperative learning strategies, diverse thinking and learning styles, and multiple intelligence theories. The differentiated teaching approach is characterized by its capacity to engage students actively in both in-class and extracurricular activities. It allows them to undertake tasks suited to their intellectual strengths, prior knowledge, readiness, and interests. Moreover, it supports activities that align with their learning and thinking styles, fosters awareness, and enhances socialization, cooperation, and communication skills through adaptable group work. By establishing connections between existing knowledge and new information, students internalize learning more effectively, with the guidance of a teacher. In light of the research findings, an effective teaching and learning process is characterized by the active involvement of both students and teachers through the implementation of methods such as the Multi-Level Teaching Method, the Station Method, the Centres Method, the Entry Points Method, and the RAFT Method. By strategically selecting the most suitable method based on the core concepts, principles, and objectives of the course, and by preparing the requisite materials, educators can enhance the enjoyment of lessons and significantly boost student engagement.

This study also provides robust evidence that differentiated instruction, when strategically implemented, significantly enhances student engagement, motivation, and academic achievement. By systematically adapting the content, process, product, and environment to align with the diverse interests, needs, readiness levels, and learning profiles of students, differentiated instruction fosters an inclusive and dynamic learning environment. Through the application of methods such as the Multi-Level Teaching Method, Station Method, Centres Method, Entry Points Method, and RAFT Method, this research offers actionable strategies for educators, demonstrating how tailored approaches can make course content more relevant, stimulating, and accessible to all students. A key contribution of this study is its nuanced approach to differentiated instruction, emphasizing the strategic application of these methods in response to students' unique learning needs. Rather than advocating for uniform differentiation across all dimensions, the study underscores the importance of targeted differentiation based on students' interests, readiness, and learning profiles. This flexibility empowers educators to focus on individual student development while maintaining the integrity of the curriculum, thus fostering a deeper connection to the material and enhancing student participation, retention, and academic success. While the findings of this study are compelling, certain limitations must be acknowledged. The research was conducted within a specific educational context, and future studies should explore the impact of differentiated instruction across a broader range of educational systems and cultural settings. Moreover, the study highlights the crucial role of teacher reflection and professional adaptation, yet the extent to which teachers are equipped to implement these differentiated methods in practice remains an area ripe for further inquiry.

This study yields several important recommendations for educators and policymakers:

- Educators should fully embrace differentiated instruction as a transformative, student-centred pedagogical approach. Professional development initiatives should equip teachers with the necessary skills and resources to effectively differentiate lessons and foster a learning environment that accommodates the diverse needs of their students.
- Policymakers must prioritize the integration of differentiated instruction into national and regional curricula, ensuring the provision of adequate resources, support, and professional training. This will enable teachers to implement differentiated strategies effectively and ensure equitable access to quality education for all students.
- Future research should explore the long-term impact of differentiated instruction on student outcomes across various educational stages and consider how emerging digital tools and AI can further enhance the customization of learning experiences.

Consequently, it could be accentuated that differentiated instruction is not merely a teaching strategy but a fundamental shift in how we approach the diverse needs of learners. Its implementation is a powerful, evidence-based means of elevating the educational experience, ensuring that all students, regardless of their background or abilities, have the opportunity to thrive. This study contributes significantly to the literature on differentiated instruction, providing not only theoretical insights but also practical solutions that can drive transformative change in educational practices worldwide.

The following suggestion can be made within the framework of the research:

This research article is conducted within the constraints of considering student success, engagement, motivation, and readiness levels. It examines the potential benefits of differentiated instruction by focusing on student achievement, course content, individual learning styles, and readiness levels. Therefore, it is recommended that future research in this field explore the following areas:

1-Teacher Training: Researchers may investigate the development and evaluation of effective training programs designed to enhance teachers' knowledge and proficiency in differentiated teaching methods.

2-In-Depth Analysis of Students' Individual Needs: Researchers may conduct detailed analyses of students' individual needs to determine how differentiated teaching strategies can more effectively address these needs.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author received no financial support for the research, authorship, and/or publication of this article.

Statements of publication ethics

I hereby declare that the study does not have any unethical issues, and that research and publication ethics have been observed carefully.

Author's Contribution Statements

The author's contribution rate is %100.

Ethics Committee Approval Information

There were no human participants in the research process due to the document review method implementation. Therefore, any ethics committee permission was not required.

REFERENCES

- Aşıroğlu, S. (2016). Investigating the relationship between teacher candidates' attitudes towards scientific research and their achievements in scientific research courses. *Uşak University Journal of Educational Research*, 2(2), 72-84. <https://doi.org/10.29065/usakead.232429>
- Baysen, E., & Silman, F. (2012). Constructivist approach. In Z. Kaya (Ed.), *Learning and teaching theories, approaches, models* (pp. 197-225). Pegem Akademi.
- Belər, Y., & Avci, S. (2011). An effective strategy in differentiating instruction: Layered instruction. *Ahi Evran University Journal of the Faculty of Education*, 12(3), 109-126.
- Braun, V. and Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101.
- Chapman, C., & King, R. (2003). *Differentiated instructional strategies for reading in the content areas*. Corwin Press. California.
- Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five approaches* (2nd ed.). Sage.
- Davis, K., Christodoulou, J., Seider, S., & Gardner, H. (2011). The theory of multiple intelligences. In R.J. Sternberg & S.B. Kaufman (Eds.), *Cambridge Handbook of Intelligence* (pp. 485-503). Cambridge, UK; New York: Cambridge University Press., Available at SSRN: <https://ssrn.com/abstract=2982593>
- Demir, S. (2021). *Differentiated teaching methods and techniques with practical examples*. Eğiten Kitap. Ankara, Turkey.
- DENİZ, Ş. (2024). A BRIEF HISTORY OF BLENDED LEARNING AND ITS IMPORTANCE IN ENGLISH LANGUAGE TEACHING. *International Journal Of Eurasia Social Sciences*, 15(55), 419–434. <https://dx.doi.org/10.35826/ijoess.4423>
- Deniz, Ş., & Alici, A. E. (2024). The Evolution of Theories, Transformations, and Emerging Trends in Distance Education Worldwide: A Comprehensive Research Article. *Kastamonu Education Journal*, 32(4), 600-611. <https://doi.org/10.24106/kefdergi.1574351>
- Gömlüksiz, M. N., & Elaldi, Ş. (2011). Teaching foreign languages within the context of the constructivist approach. *Turkish Studies: International Periodical for the Languages, Literature and History of Turkish or Turkic*, 6(2), 443-454.
- Gregory, G. H., & Chapman, C. (2020). *One size does not fit all: Differentiated instruction strategies*. Pegem Akademi.
- Hall, T., Vue, G., Strangman, N., & Meyer, A. (2003). *Differentiated instruction and implications for UDL implementation*. Wakefield, MA: National Center on Accessing the General Curriculum. (Links updated 2014). Retrieved [Mayıs 2024] from <http://www.cast.org/products-services/resources/2003/ncac-differentiated-instruction-udl>
- Heacox, D. (2002). *Differentiating instruction in the regular classroom: How to reach and teach all learners, grades 3-12*. USA: Free Spirit Publishing.
- Karadağ, R. (2010). *The implementation of differentiated instruction approach in primary school Turkish language courses: An action research* (Doctoral dissertation). Anadolu University, Institute of Educational Sciences, Eskişehir, Turkey.
- Kılınç, Ş. and Sözer M. A. (2023). *Differentiated instruction*. Ankara: Pegem Akademi.
- Miles, M. B. and Huberman, A. M. (1984). Drawing valid meaning from qualitative data: Toward a shared craft. *Educational Researcher*, 13, 20-30. [doi:10.3102/0013189X013005020](https://doi.org/10.3102/0013189X013005020)
- Parsons, S. A., Dodman, S. L., & Burrowbridge, S. C. (2013). Broadening the view of differentiated instruction. *Phi Delta Kappan*, 95(1), 38-42.
- Taşpınar, M. (2012). *From theory to practice: Principles and methods of teaching*. Elhan Kitap Yayın Dağıtım. Ankara, Turkey.

- Tillman, K. (2020). *The administration of physical education, sport, and leisure programs* (6th ed.). Boston: McGraw-Hill Education.
- Tomlinson, C. A. (1999). *The differentiated classroom: Responding to the needs of all learners*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Tomlinson, C. A. (2005) *The differentiated classroom: Responding to the needs of all learners*. ABD: Pearson Merrill Prentice Hall.
- Tomlinson, C. A. (2017). How to differentiate instruction in academically diverse classrooms. (Rrd ed.). ASCD.
- Webster, J., & Watson, R. T. (2002). Analysing the past to prepare for the future: Writing a literature review. *MIS Quarterly*, xiii-xxiii.
- Zoraloğlu, S., & Şahin, A. E. (2022). Teacher competencies for the differentiated instruction approach. *Çukurova University Journal of the Faculty of Education*, 51(2), 1377–1416.
- Zorlu, F. (2020). Examining the views and suggestions of pre-service science teachers on the application of the cooperative learning model in distance education environments. *International Journal of Social and Educational Sciences*, 7(1), 219–232.



| Research Article / Araştırma Makalesi |

The Effect of The Quantum Learning on Students' Academic Achievements Social Studies Course¹

Sosyal Bilgiler Dersinde Kuantum Öğrenmenin Öğrencilerin Akademik Başarılarına Etkisi

Betul YILDIZ², Hüseyin BAYRAM³

Keywords

1. Social studies course
2. Quantum learning model
3. Academic achievement

Anahtar Kelimeler

1. Sosyal bilgiler dersi
2. Kuantum öğrenme modeli
3. Akademik başarı

Received/Başvuru Tarihi
19.12.2024

Accepted/Kabul Tarihi
25.07.2025

Abstract

Purpose: The main purpose of this research is to determine the effect of the quantum learning model in social studies course on students' academic achievements.

Design/Methodology/Approach: Using the mixed research method with an embedded design, the participants of this research consist of 5th-grade students and their social studies teacher studying in a public middle-school in Türkiye's Van province in the spring term of the 2023-2024. The research data was collected through academic achievement tests, semi-structured interview forms, unstructured observations, and researcher's diary. Statistical analysis of the research data utilized t-tests and covariance analysis for independent samples, while content analysis was employed for qualitative data analysis.

Results: The research concluded that the quantum learning model contributed to enhancing students' academic achievements. Both the social studies teacher and students involved in the research acknowledged the various benefits of the quantum learning model in social studies education. The results have led to recommendations for practice and further research.

Highlights: Examining the alternative approaches aimed at improving students' academic achievement in social studies is important in terms of research in the field of education. In this context, scientific research examining the effect of the quantum learning model on student achievement can contribute to the field.

Öz

Çalışmanın amacı: Bu araştırmanın temel amacı, sosyal bilgiler dersinde kuantum öğrenme modelinin öğrencilerin akademik başarıları üzerindeki etkisini belirlemektir.

Materyal ve Yöntem: Karma araştırma yönteminden gömülü desen kullanılarak gerçekleştirilen bu araştırmanın katılımcıları, 2023-2024 bahar döneminde Türkiye'nin Van ilinde bir devlet ortaokulunda okuyan 5. sınıf öğrencileri ve onların sosyal bilgiler öğretmenlerinden oluşmaktadır. Araştırma verileri, akademik başarı testi, yarı yapılandırılmış görüşme formu, yapılandırılmamış gözlem ve araştırmacı günlüğü aracılığıyla toplanmıştır. Araştırma istatistiksel verilerinin analizi için bağımsız örneklem için t-testi ve kovaryans analizi kullanılırken, nitel verilerinin analizi için içerik analizi kullanılmıştır.

Bulgular: Araştırmada kuantum öğrenme modelinin öğrencilerin akademik başarılarını artırdığı sonucuna varılmıştır. Araştırmaya katılan sosyal bilgiler öğretmeni ve öğrencilerin sosyal bilgiler eğitiminde kuantum öğrenme modelinin kullanımının çok çeşitli yararlar sağladığı görüşüne sahip oldukları belirlenmiştir. Araştırmada ulaşılan sonuçlar kapsamında uygulama ve gelecek araştırmalar için önerilerde bulunulmuştur.

Önemli Vurgular: Sosyal bilgiler dersinde öğrencilerin akademik başarılarını artırmaya yönelik alternatif yaklaşımların incelenmesi, eğitim alanındaki araştırmalar açısından önemlidir. Bu çerçevede, kuantum öğrenme modelinin öğrenci başarıları üzerindeki etkisini ele alan, bilimsel araştırmalar alana katkı sağlayabilir.

¹ This research is derived from Betül YILDIZ's master's thesis entitled "5. Sınıf Sosyal Bilgiler Dersinde Kuantum Öğrenme Modelinin Öğrencilerin Akademik Başarılarına Etkisi" conducted under the supervision of Hüseyin BAYRAM.

² Corresponded Author, PhD in Social Studies Education, Anadolu University, Eskişehir, Türkiye; <https://orcid.org/0000-0001-6651-9129>

³ Department of Social Studies Education, Ağrı İbrahim Çeçen University, Ağrı, Türkiye; <https://orcid.org/0000-0001-6065-8865>

INTRODUCTION

The social studies course aims to provide students with a wide range of qualifications that they can use in daily life (Barr, Barth, & Shermis, 1978; Barr, 1997). It can be said that the realisation of the aforementioned aim of the social studies course depends on effective learning processes (Whitworth & Berson, 2003). A wide variety of learning methods/ techniques/ models can be utilized in social studies course. It can be said that one of the learning models used to ensure effective learning processes in social studies course is the quantum learning model (QLM) (Ünal, 2019; Fenar, 2021).

QLM is a learning model based on quantum thinking style and quantum information theory and based on the principles of quantum mechanics (Given & DePorter, 2015). Unlike the learning models used in educational processes, QLM is based on the theoretical prediction of knowledge and then designing it within the scope of intensive cognitive processes (Conti, 2023). On the other hand, it is a learning model that focuses on developing students' skills through multidimensional thinking and learning processes and at the same time providing permanent learning (DePorter & Hernacki, 1992). There are various learning theories and approaches that constitute the philosophical and practical basemend of the QLM. The learning theories and approaches are as follows: Suggestopedia approach, accelerated learning approach, neurolinguistic programming approach (NLP), holistic learning approach, right-left brain theory, triple brain theory, multiple intelligence theory and learning style approach (DePorter, Reardon, & Nourie, 1998).

The process in the training activities of QLM are experienced is referred to as the quantum learning cycle. Quantum learning cycle consists of six interrelated stages. Each of these stages acts in a part-whole relationship in the education process (Çırak, 2016). According to QLM, this is a cycle that appeals to individuals of all ages and learning style (DePorter & Hernacki, 1992). The stage in the quantum learning cycle are visualised in Figure 1:

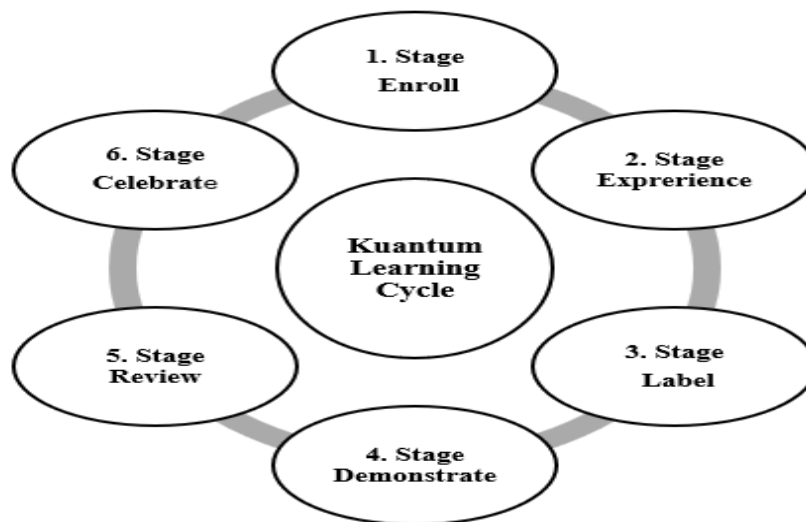


Figure 1. Quantum Learning Cycle (Ekici,2019)

The stages of the quantum learning cycle, which is formed according to the principle of interrelated and mutual complementarity, consist of the steps of capturing (enroll), associating with experiences (experience), labelling (label), demonstrating (demonstrate), reviewing (review) and celebrating (celebrate) (Ekici, 2019). In addition to providing students with a wide range of qualifications, the QLM aims to improve students' academic achievement (Le Tellier, 2006). In this respect, it is hypothesised that the QLM is a model that can be used in social studies courses to improve students' academic achievement.

The hypothesis is based on the fact that the QLM, just like the social studies course, focuses on skill acquisition and focusing on situations related to daily life (Given & DePorter, 2015). During the review conducted to establish the research's theoretical foundations, three studies (Çelik, 2017; Ünal, 2019; Fenar, 2021; Arıkan, 2023) were found in which the QLM was used in social studies course to improve academic achievement. It was determined that these studies were conducted in grades 4, 6 and 7 and concluded that they improved academic achievement. One of the mentioned studies was conducted in the learning theme of "Production, Distribution and Consumption" (Çelik, 2017), one in the learning theme of "People, Places and Environments" (Ünal, 2019) and one in the learning themes of "Production, Distrubiton and Consumption" and "Active Citizenship". This research was conducted in the learning theme of "Science, Technology and Society", which is assumed to be the most appropriate learning theme for the nature of the QLM. It was thought that the potential of the QLM would be revealed in the mentioned learning theme. As, the content of "Science, Technology and Society" learning theme can be thought that its contatible with the structure of the QLM. This research conducted in the 5th grades is thought to raise awareness about the effective use of the QLM in the social studies course on the basis of the framework explained.

Aim

The aim of this research is to determine the effect of the QLM based on social studies education on students' academic achievement in 5th grade. In line with this aim, a hypothesis was tested and two questions were sought. The hypothesis and questions are as follows:

- Hypothesis: Is there a significant difference between academic achievement of the experimental and control groups in favor of the experimental group?
- Question 1: What are the students' views and experiences regarding the QLM based social studies education's effect on their academic achievement?
- Question 2: What are the social studies teacher's views and experiences regarding the QLM based social studies education's effect on students' academic achievement?

Limitations

This research is limited to

- the activities prepared for the 5th grade Social Studies course "*Science, Technology and Society*" learning theme in the 2023-2024's spring semester.
- a six-week treatmental procedure.
- the findings obtained from the data collected through the academic achievement test, semi-structured interview form, researcher's diary and unstructured observation form.
- the results reached from the data obtained from the students took part in the research and their social studies teacher.

METHOD

Embedded-mixed design was utilized for the experimentally designed research. The design in question is intended to enrich treatmental procedures with qualitative data collection and analysis stages (Creswell & Plano Clark, 2017). The aim of utilizing this design is that the statistical findings of the research are intended to be examined in depth with semi structured interviews and unstructured observation findings. The procedure followed in the research is shown in Figure 2:

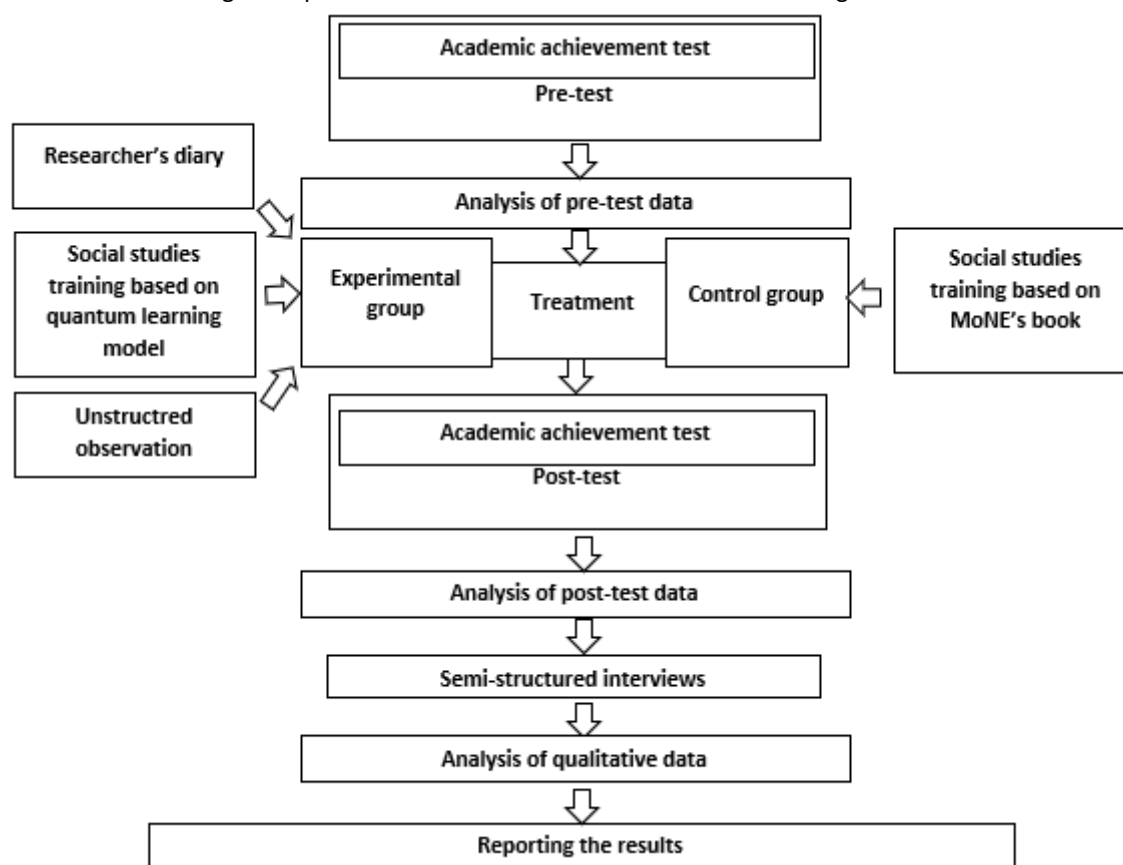


Figure 2. The Procedure Followed in the Research

As seen in Figure 2, in the first stage of the research, the pretest was applied to the experimental and control groups and the first statistical data were collected. Then, the data were analyzed and filed. In the next stage, the experimental process of the research was applied and during the experiment the primary qualitative data were collected from the students through the

unstructured observation technique and the researcher's diary. After the end of the experimental process, the post-test was applied to the groups and the secondary statistical data were collected and analyzed. Then interviews were conducted with the social studies teacher and volunteer students in the experimental group using semi-structured interview forms and secondary qualitative data were collected. The findings obtained from observations, interviews and the researcher's diary were brought together and analyzed to support the statistical findings. In the last stage, the statistical and qualitative findings were combined and the research results were reported.

Participants

The participant group consists of two parts. The first part consists of the students that statistical data were collected. The second part consists of the students and the social studies teacher who were interviewed.

The first part consisted of the students studying in two 5th grade classes of a middle-school in Van province of Türkiye in the spring semester of the 2023-2024. Criterion sampling method was used to determine the group. This method is based on the selection of data sources with the qualifications determined by the researcher (Büyüköztürk et al., 2020). While forming the first group it was determined as a criterion that the school where the research would be conducted was at a medium academic achievement level and that it had at least two 5th grade classes. The reason for considering the medium level of academic achievement as a criterion is based on the assumption that the dependent variable of the research would not be measured accurately in schools with high or low academic achievement levels. The reason for conducting the research with 5th grade students is that the scientific research methods course was first started to be given in the 5th grade. Information about the groups is given in Table 1.

Table 1. Information About the Participants

Information		Experimental		Control	
		<i>f</i>	%	<i>f</i>	%
Gender	Girl	10	45.45	10	43.48
	Boy	12	54.55	13	56.52
Total		22	100	23	100

As seen in the Table 1 the experimental group included 22 students, 10 of whom were girl (45.45%) and 12 of whom were boy (54.55%), and 23 students in the control group, 10 of whom were girl (43.48%) and 13 of whom were male (56.52%).

The interviewed group was formed with the volunteer students and the social studies teacher. A total of 8 participants, 7 students and 1 social studies teacher, took part in the group. The names of the students interviewed were concealed; instead, each student was given a code name as S1, S2, S3....

Data Collection

The data collection tools are presented under headings. The headings are as follows.

- **Science, Technology and Society Achievement Test (STSAT):** The statistical data were collected through the STSAT. The STSAT developed by Şerefli (2020). The developer calculated the Kuder Richardson (KR)-20 as .77. The KR-20 was calculated to determine whether the STSAT was suitable for use in this research and found as .75. Each item of the test was evaluated between 0 and 1 point. The highest score that can be obtained from the 27-item test is 27 and the lowest score is 0.
- **Semi-structured Interview Forms:** Semi-structured interview forms were used in order to reveal the views and experiences of the students and the social studies teacher regarding the experimental process. Expert opinion was taken during the development process of the forms. Within the scope of the feedback, the questions in the forms were revised. The forms were also piloted.
- **Researcher's Diary:** Experiences, feelings, thoughts, problems, solutions, and suggestions during the research process were kept regularly in the researcher's diary.
- **Unstructured Observaton form:** Unstructured observations were made to observe the activities carried out in the experimental process of the research.

Data Analysis

In the research, statistical data were analyzed first. Various procedures were carried out to determine the tests to analyze the statistical data. In this context, the skewness (SKW), kurtosis (KRT) and Shapiro Wilk (S-W) scores of the STSAT data were examined. The reason for using the S-W test is that there were less than 35 students in each group. The SKW, KRT and S-W results are shown in Table 2.

Table 2. SKW, KRT and S-W Results

Group	Pre-test			Post-test		
	SKW	KRT	S-W	SKW	KRT	S-W
Experimental	-.466	-.776	.088	-.485	-.427	.224
Control	.860	1.457	.115	.208	-.877	.362

For pre-test data, experimental group's SKW was -.466, the KRT was -.776 and S-W was .08. Control group's SKW was .860, the KRT was 1.457 and S-W was .115. For post-test data, experimental group's SKW was .484, the KRT was -.427 and S-W was .224. Control group's SKW was .208, the KRT was -.877 and S-W was .362. Based on the fact that the SKW and KRT values of the pre and post tests were between -1.5 and 1.5 and the S-W values were greater than .05 (Tabachnik, & Fidel, 2019), the data were normally distributed. The statistical data were analyzed through parametric tests.

Then, it was investigated which tests would be used. In order to be able to use covariance analysis, the presence of a linear relationship between the post-test scores, which is the dependent variable of the research, and the pre-test scores, which is the covariate, was investigated. In addition, within-group regression coefficients were checked. It was determined that there was a linear relationship between the dependent variable and the covariate and that the coefficients were equal. Due to the results obtained, parametric tests utilized in the statistical analysis.

During the analyzing of the quantitative data content analysis was utilized. Expert opinion was consulted to determine whether the analysis was done correctly.

Validity and Reliability

For the validity and reliability in the research, various stages were followed. These stages are listed below:

- Reliability test were conducted for the STSAT.
- Six experts' opinions were consulted on the appropriateness of the interview forms.
- The interview forms were piloted.
- The qualitative codes, themes and %25 of the raw data were sent to experts to get their opinions on whether the analysis was done correctly.

RESULTS

The results obtained were interpreted and explained under headings.

The Effect of QLM on Students' Academic Achievement

The STSAT was conducted to the groups before the treatment. Independent samples t-test was used to determine the groups' scores. The scores are shown in Table 3.

Table 3. Results of the Independent Samples t Test

Group	<i>n</i>	$\bar{x}$	<i>sd</i>	<i>df</i>	<i>t</i>	<i>p</i>
Experimental	22	12.45	2.132	43	.721	.475
Control	23	11.95	2.476			

Due to the values in Table 3, it was concluded that there was no significant difference between the groups' scores ($t_{(43)} = .721$; $p = .475 > .05$). After the experimental procedure The STSAT conducted. The descriptive statistics of the post test are given in Table 4.

Table 4. Descriptive Statistics

Group	<i>n</i>	$\bar{x}$	<i>sd</i>
Experimental	22	20.36	3.170
Control	23	12.08	2.410

As seen in Table 4, the experimental group's mean post test score was 20.36, control group's was 12.08. Analysis of covariance was applied to investigate whether the results were statistically significant. Before conducting the covariance analysis, within-group regression coefficients were checked. The results are below.

Table 5. Within-Group Regression Coefficients

Source of Variation	Sum of Squares	df	Mean of Squares	F	p
Corrected model	888.063	3	296.021	54.884	.000
Group	62.491	1	62.491	11.586	.001
Pre-test	93.547	1	93.547	17.344	.000
GroupxPre-test	10.187	1	10.187	1.889	.177
Error	221.137	41	5.394		
Total	12822.000	45			

According to the values in Table 5 ($F_{(1; 41)} = 1.889$; $p = .177 > .05$), it was determined that the within-group regression coefficients were equal. The results of the analysis of covariance are shown in Table 6.

Table 6. Results of Analysis of Covariance

Source of Variation	Sum of Squares	df	Mean of Squares	F	p	η^2	Observed Power
Corrected model	877.876	2	438.938	79.695	.000	.791	1.000
Pre-test	107.593	1	107.593	19.535	.000	.317	.991
Group	699.770	1	699.770	127.053	.000	.752	1.000
Error	231.324	42	5.508				
Total	12822	45					

Table 6 shows that, the p value is .00. By the result it can be said that the treatment procedure yielded sonuç ($F_{(1; 42)} = 127.053$; $p = .00 < .05$) significant results. Since the effect size was .752, which is greater than .14 (Cohen, 2013), the experiment's effect was large.

Table 6 also shows that, the experiment's power was 1.000, which is greater than .80 (Christensen, Johnson, & Turner, 2014). In this context, H_1 was confirmed by 100%.

The results showed that the treatment procedure developed the students' academic achievement levels.

Student Views and Experiences Regarding the Effect of QLM Academic Achievement

The findings related to the students' views and experiences about QLM's effect on their academic achievement were grouped under five themes: "QLM", "The effect of QLM on academic achievement", "The effect of QLM on gaining various skills", "The effect of QLM on gaining various affective features", and "The effect of QLM on gaining various values". The findings are below.

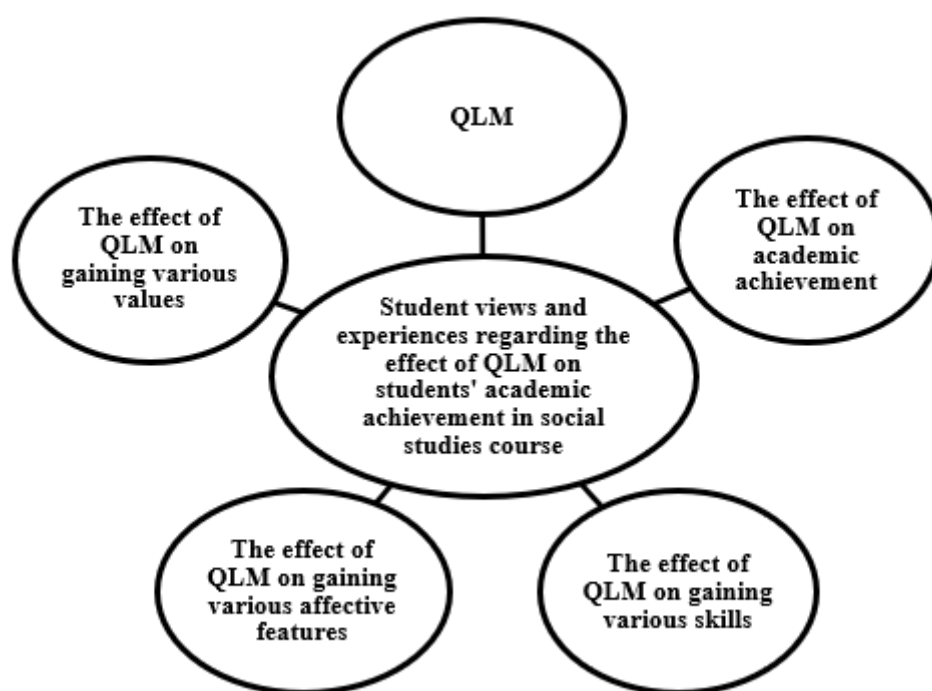


Figure 3. Student Views and Experiences Regarding the QLM's Effect on Students' Academic Achievement

The findings revealed that the students found the QLM entertaining. For example, 07 said, *"I used to be a little bored in the previous social studies course, there was always chaos, but I was never bored in this course, in fact, I had a lot of fun with my friends, and I also learned."* This student emphasized that the QLM made learning entertaining.

It was determined that some of the students were of the view that the QLM increased their motivation in the social studies course. S7 said, *"I understood unit four very well, we did activities, solved questions and took notes, which helped me understand the subjects better. I didn't have much desire to participate in the course before, but different things in the course increased my desire to study."* It was determined that the QLM made learning meaningful and encouraged the student to participate in the courses.

In the research, it was determined that the QLM contributed to enhancing the retention of knowledge. For example, S6 said, *"I learned better when our courses were taught in this way, I remember most of the topics in this course, there may be some things I don't remember, but most of the information is in my mind now."*

Some students stated that social studies education based on the QLM aroused curiosity in them. S6 said, *"Quantum learning was a little different, but the activities in the course aroused curiosity in me, I was curious about the subject, I was curious that we were going to learn new things, and I was a little excited because our other courses were always the same."* He/she made a comparison with the previous courses in the implementation of the QLM and made an evaluation on the curiosity arousing effect of the social studies courses based on the QLM.

Some students found the education carried out with the QLM useful in terms of its effect on students' academic achievement. For example, S2 stated, *"Our teacher taught us how to use some websites by doing activities with cards, if she had not done it with activities, I would not have cared much, but it was good for me when she did it like this."*

This research has revealed that the courses conducted with the use of the QLM helped students gain communication, cooperation, decision-making, empathy, self-control, research and inquiry skills. S1, who stated that the QLM improved his/her communication skills, said, *"In the posters we made, for example, I understood the word plagiarism better when we prepared the word 'I do research, I do not plagiarize' in the form of a poster. When we did this activity, I communicated more with my friends, everyone expressed their views, and we listened to each other."*

Some students thought that the QLM provided them with research skills within the scope of its effect on students' academic achievement. For example, S7 said, *"I learned how to reach the right information and then I had to do research on a subject. When I went home, I researched the things I learned by myself."*

Some of the students in the research stated that social studies education based on the QLM improved students' collaboration skills. For example, S3 said, *"We had fun and learned many good things with our friends. For example, we helped each other when we were working on posters as a group, and then we supported each other when we were debating"*.

It was observed that some students explained the view that social studies education based on the QLM provided them with empathy skills. One of these students, S1, said, *"When we debated, I tried to understand what my friends were thinking and feeling,*

I listened to them until the end, it was a good time for me." In this context, it was determined that the QLM helped students to understand different perspectives, to feel the feelings of others and contributed to the development of students' empathy skills.

Some students explained views that social studies education based on the QLM provided them with self-control skills. S3 stated that the notay technique strengthened their ability to express and organize their feelings and thoughts effectively and to trace these processes with the words *"I wrote down my feelings and thoughts, and I also wrote down the questions I had in my mind."* Indeed, the techniques included in the QLM help students to develop their self-control skills and form an important basis for their academic success.

In the research, it was found that the social studies education based on the QLM improved students' decision-making skills. For example, S3 stated that the courses carried out with the QLM helped him/her gain decision-making skills with his words such as *"We realized that we had to make a joint decision while working in groups with our friends because at first we were all saying different things and there was confusion, then we combined what everyone said and came up with a poster article."*

In the research, for some students, the QLM was effective in developing their creativity skills. For example, S5 expressed the positive effect of the QLM on creativity skills by saying, *"We learned the benefits and harms of technology with the debate technique, we worked with my friends here and different ideas emerged."* It was determined that the students thought that the QLM contributed to their academic achievement by providing them with various skills.

From the data obtained, it was determined that the views of the students about the QLM were related to the fact that the QLM provided affective features such as motivation, eagerness to learn, willing participation, self-esteem, and interest. For example, S1 stated, *"In the previous courses, I did not always ask for the right to speak, but when these courses were very fun, I participated and learned with fun. I told our teacher that our other courses should always be taught in this way."* In his/her statement, he/she stated that the QLM positively affected learning and motivation arose from intrinsic factors. S7 stated, *"I was hesitant to ask questions in the courses, but when everyone participated and the courses were fun, I wanted to participate in the courses."* He/she stated that while he/she was hesitant to ask questions in the previous courses, he/she wanted to participate more in the courses because of the active participation of everyone and the fun of the courses in the social studies courses taught according to the QLM.

It was determined that some of the participants stated that the QLM made them eager to learn new information. For example, S1 said, *"We learned new things as we did activities in the course, I like to learn new things and I liked it more with these courses."*

It was determined that the QLM process aroused the desire of some students to participate in the courses. For example, O4 stated, *"I did not have much desire to participate in the previous social studies course, but the different things in this course increased my desire to participate and my willingness to work."*

It was determined that some of the participants expressed the views that the QLM increased academic achievement and that there was no difference in academic achievement. In this regard, S6 emphasized that the social studies courses taught with the QLM increased his/her academic achievement with the words *"After the course, I took a test conducted by the school and I remembered the questions there more easily. I mean, I realized that I remembered more easily. In my success, I realized that I solved those questions better and I immediately remembered that I solved them better."*

One student stated that the QLM did not make a difference in their academic achievement. The student in question, S5, said, *"It was useful for me, but I don't think it affected my success in the courses much, but most of the subjects stayed in my mind. It was a little different for me because I was used to memorization. The topics were very useful, but I did not feel much change in my success."*

S2, who expressed the view that the debate technique in the QLM provided him/her with the value of responsibility, said, *"My favorite technique was the debate technique because it was very fun and educational for me, everyone fulfilled their duties properly."*

During the observations, it was determined that some students acquired the value of respect. Throughout the process, the social studies teacher included all students in every course to ensure that each student actively participated in the course. Observations revealed that students treated each other with respect in group work.

It was determined that the QLM contributed to students' acquisition of the value of diligence. As a matter of fact, by the results from the researcher's diaries, it was determined that the homework assignments given during the treatment were brought by the participants in a complete manner.

Teacher Views and Experiences Regarding the Effect of QLM on Students' Academic Achievement in Social Studies Course

To determine the views and experiences of the social studies teacher involved in the research, an interview was conducted with the teacher after the implementation process. The findings obtained from the interviews are below.

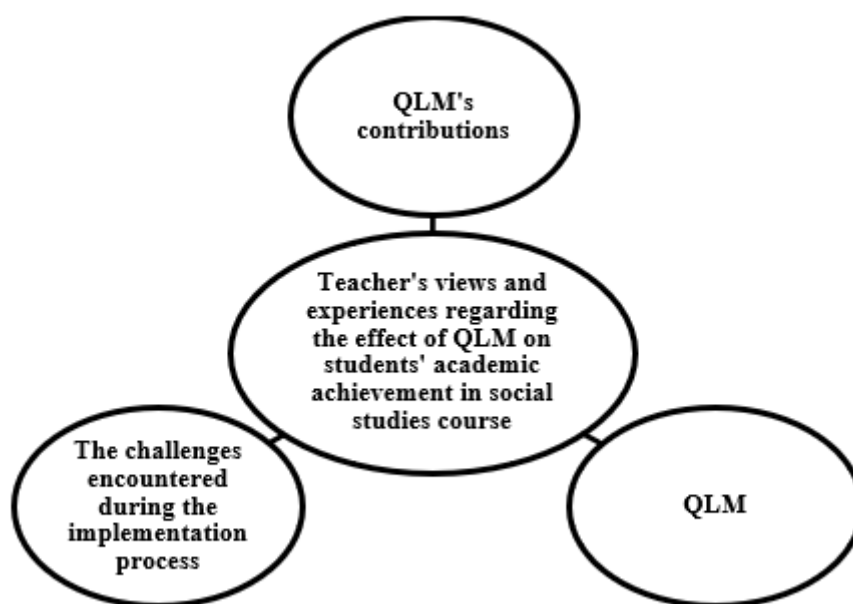


Figure 4. Teacher's Views and Experiences Regarding the QLM's Effect on Academic Achievement

It is seen that the findings related to teacher's views and experiences regarding the QLM's on academic achievement consist of three sub-themes: The social studies teacher's views on the QLM's contributions, the social studies teacher's views on the QLM, and the challenges encountered during the implementation process.

The teacher stated that the participation of the students in the QLM activities was impressive. He/he expressed the participation of students within the scope of QLM as follows:

"Students generally participated actively in the process. Therefore, it was a dynamic application. Both activities and model-specific techniques enabled students to participate in the course. Sometimes I would struggle to include all students in the course, but I did not struggle much in this process. It was an impressive six weeks."

The social studies teacher stated that the activities and group work implemented within the scope of the QLM motivated the students during the process. The teacher said, *"Students easily participated in the course and there was interest and curiosity in their participation. Throughout the process, I noticed a steady increase in my children's motivation. As the students became more motivated, they felt valuable and successful. This situation made me extremely pleased."* The teacher expressed his/her view that quantum learning increased students' interest and curiosity in the course.

The teacher stated that the QLM were useful for both the students and himself/herself as follows:

"All of the activities and games included in the QLM were things that would contribute to the students and me in general. I am going to use some of the techniques in the QLM and I learnt from the feedback I received from my students that they also used them in other courses. It was a very useful process in this regard."

It is understood that the social studies teacher stated that the contribution of the QLM to the permanent learning of the students and the contribution to academic achievement. As a matter of fact, the teacher clearly concretised his/her view on the subject in his statement as *"I think that students learn more permanently because they produce and do something during the learning process."*

It was observed that the teacher was of the view that the QLM increased the students' the academic achievement. The teacher said, *"I noticed that the children answered the questions about the subject easily. Their interest and curiosity increased. These, in turn, increased the students' academic success."* the teacher expressed.

It was found that the social studies teacher encountered various difficulties arising from the QLM.

The teacher stated that one of the difficulties encountered in the treatment based on QLM was the insufficient number of weekly course hours:

"The activities and games you prepared were very good, but I made a special effort to complete the activities, and sometimes the activities were interrupted, as you have seen. Utilizing the time is necessary to fulfil the activities in the QLM as efficiently as they are."

Another difficulty experienced in the research was determined that having a crowded class was among the difficulties seen by the teacher in the implementation of the QLM. Regarding this issue, the teacher uttered:

"Since the class was a little crowded, the time was insufficient for many activities. The crowded class made it difficult for me to maintain control during the activities from time to time."

It was determined that the teacher encountered some challenges during the treatment within the scope of the effect of the experiment.

CONCLUSION AND DISCUSSION

The results of the study were interpreted and conclusions were reached. These results are discussed in the light of similar studies in the literature.

It has been found that the use of the QLM in social studies course increased the students' academic achievement. It can be said that activities based on the QLM in the social studies course are useful tools to improve students' academic achievement. The QLM supports students' emotional, cognitive and social dimensions with a holistic approach based on the natural learning processes of the brain. The application of the QLM in the social studies course can increase students' learning motivation and enable them to construct knowledge in a meaningful and permanent way. Davis (2012) argued that teachers who utilized the QLM had more successful students than teachers who did not use the QLM. Benn (2003), at the end of the research in which they evaluated the effect of QLM on student achievement in basic academic subjects, it was determined that QLM increased students' academic achievement. At the stage, it was concluded that students found social studies education based on QLM fun, motivating, permanent, useful, intriguing, while a few found it boring and distracting. Sujatmika et al. (2018), in their research, concluded that QLM attracted students' attention and provided students with a fun learning environment. Fenar (2021), concluded that the students in the experimental group in the 6th grade social studies course, in which the QLM was applied, found the courses taught with this model fun. On the other hand, Khozaei et al. (2022), examined the effect of QLM and traditional teaching methods on students' learning achievement, motivation and retention in their research. It was determined that the QLM was an effective method in increasing students' learning motivation and retention. In his research, Çelik (2021), concluded that the activities in the Turkish courses taught with the QLM aroused students' curiosity and motivated them.

It was determined that the participants in the research were of the view that social studies education based on the QLM provided them with various skills such as creativity, communication, cooperation, research, empathy, self-control, and decision-making. Through activities based on the QLM in the social studies course, students can gain a wide range of skills and be better equipped for the future. As a matter of fact, the QLM enriches the learning process by focusing on students' individual characteristics and potentials and provides them with a wide range of skills such as critical thinking, problem solving, cooperation, creativity and communication. Caturiasari et al. (2023), based on the results of the social studies course conducted with the QLM in the research, it was determined that the QLM was effective in developing students' creative thinking ability. Nourie (1998), in his research, concluded that quantum learning increases students' communication skills. Nahar et al. (2022), in their research, it was concluded that the students' collaborative thinking skills were improved by the use of the QLM. The researcher concluded that the social studies courses taught with QLM positively affected decision-making, self-control and empathy skills. The findings regarding these skills were not revealed by other researchers in the literature. Ay (2010), in his research, concluded that the QLM had a positive effect on students' self-directed learning. Çelik (2021), in his research, concluded that the QLM directed students to research.

In the research, it was concluded that social studies education based on the QLM provided students with various affective features. The QLM focuses on the emotional state and motivation of the individual as well as many other factors in the learning process. When the QLM is applied in the social studies course, it can contribute to the development of a wide range of affective characteristics. Indeed, the QLM allows students to increase their intrinsic motivation in the learning process. This can support students' deeper understanding of social events. Güllü (2010), in his research, concluded that the students' willingness to learn was positively affected by the use of the QLM. Suryani (2013), in his research, concluded that the use of QLM in history teaching increased student interest. Hinton et al. (2008), in their research, examined the effect of QLM on secondary school students' self-efficacy. They concluded that the QLM positively affected students' self-efficacy and at the same time, students actively participated in the courses. In the research, one of the affective features gained by the students from the QLM is self-esteem. Affective features in QLM have a multifaceted and significant effect on students' academic achievement.

In the research, it was concluded that the value of responsibility, diligence and respect were gained by the students. Social studies education based on the QLM can be an effective approach to help students acquire various values. As a matter of fact, this model plans the learning process with a holistic approach that supports students' emotional and cognitive development. In fact, thanks to the collaborative work processes of the QLM, students can acquire basic values for social life. Demir (2006), concluded that quantum learning seminars conducted for students increased students' sense of responsibility and gave them the value of respect. There is no other research in the literature that reached a similar conclusion. In this research, it has been revealed that the QLM applied in the social studies course provides students with values that affect their academic achievement.

Based on the views of the social studies teacher, it was concluded that the QLM is an approach that encourages students' active participation. The QLM encourages students' active participation in the education process due to its multidimensional structure. The QLM enables students to learn by having fun as it realizes learning not only as a transfer of knowledge but also as a dynamic process in which students include their feelings, thoughts and experiences in the process. Trice (2012), in his research,

revealed that QLM is an important method on active participation and retention. Şimşek (2016), in his research, concluded that the QLM increased the academic achievement of the students in the experimental group.

In the research, it was found that the teacher encountered some challenges in the implementation process. The quantum learning model can be a difficult model to implement because it contains elements of many teaching approaches as well as psychological and psychiatric doctrines. In this context, there may be difficulties in the implementation of quantum learning by teachers. Şöhretli (2014), concluded in his research that the implementation of the QLM in crowded classes caused confusion among students. This research examined the impact of the QLM in social studies course on academic achievement. In addition, it has been argued that the QLM provides students with various skills, values and affective features. In this context, it has been determined that the results obtained are consistent with the results of similar studies. It was concluded that the QLM is a useful learning method to increase students' academic achievement.

RECOMMENDATIONS

Various recommendations were developed in the research. The recommendations are categorized under two headings: for researchers and for education planners.

Recommendations for Researchers

- The effect of social studies education based on the QLM on students' academic achievement could be researched in different grade levels.
- The effect of social studies teaching based on the QLM on the acquisition of alternative skills can be researched.
- The effect of the QLM based social studies education on acquisition of knowledge, values and affective features could be researched.

Recommendations for Education Planners

- The Council of Higher Education can teach courses on increasing students' academic achievement through the QLM in social studies teacher training programs.
- The Ministry of National Education can place content related to increasing academic achievement based on the QLM in social studies coursebooks.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Statements of Publication Ethics

I/We hereby declare that the research has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' Contribution Rate

The researchers' contribution rates in this research are as follows: Betül YILDIZ, 70%; Hüseyin BAYRAM, 30%.

Ethics Committee Approval Information

The research was conducted within the scope of the permission granted by the decision of Ağrı İbrahim Çeçen University Scientific Research Ethics Committee dated 29.02.2024 and numbered 63.

REFERENCES

- Ay, Y. (2010). *The effect of science and technology education based on quantum learning model on primary school students' academic achievement, attitude towards the course and self-learning skills* (Master's dissertation). Eskişehir Osmangazi University, Institute of Science, Türkiye.
- Arikan, A. (2023). *Examining the effect of the quantum learning model on secondary school students' spatial skill self-efficacy and spatial skills* (PhD dissertation). Gazi University, Institute of Educational Sciences, Türkiye.
- Barr, H. (1997). *Defining social studies*. Teachers and curriculum. <https://doi.org/10.15663/tandc.v1i1.288>
- Barr, R. D., Barth, J. L., & Shermis, S. S. (1978). *Defining the social studies* (No. 51). National Council for the Social Studies. <https://www.socialstudies.org/about/definition-social-studies>
- Benn, W. (2003). *Evaluation study of quantum learning's impact on achievement in multiple settings* (Master's dissertation). California University, Department of Education, USA:

- Büyükoztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2020). *Eğitimde bilimsel araştırma yöntemleri [Scientific research methods in education]*. Pegem Academy Publication.
- Caturiasari, J., Mulyani, S., & Sirait, E.M. (2023). Application of quantum teaching learning model to improve creative thinking ability of elementary school. *International Conference on Elementary Education*, 5(1), 372-379. <http://proceedings2.upi.edu/index.php/icee/article/view/3132>
- Christensen, L. B., Johnson, R. B., & Turner, L. A. (2015). *Araştırma yöntemleri: Desen ve analiz [Research methods: Design and analysis]*. (Trans.. Ed. A. Aypay). Anı Publication.
- Creswell, J. W., & Plano Clark, V. L. (2017). *Designing and conducting mixed methods research*. Sage Publications.
- Cohen, J. (2013). *Statistical power analysis for the behavioral sciences*. Academic Press.
- Conti, C. (2023). *Quantum machine learning*. Springer.
- Çelik, H. (2021). *Individual research on the application of quantum learning approach in secondary school Turkish course* (PhD dissertation). Necmettin Erbakan University, Institute of Educational Sciences, Türkiye.
- Çırak, S. (2016). Investigation of blended learning supported by the quantum learning design framework from the perspectives of prospective teachers by using q method. *Hatay Mustafa Kemal University Journal of Social Sciences Institute*, 13(35), 34-35. <https://dergipark.org.tr/en/pub/mkusbed/issue/24546/259983>
- Davis, W. A. (2012). *The effect of quantum learning on standardized test scores versus schools that do not use quantum learning*. Department of Educational Leadership College of Education and Human Services: Northwest Missouri State University Missouri, USA
- Demir, S. (2006). *The effect of the quantum learning model on student success at secondary education level (Gaziantep example)* (PhD dissertation). Gaziantep University, Institute of Social Sciences, Türkiye.
- DePorter, B., & Hernacki, M. (1992). *Quantum learning: Unseashing the genius in you*. Dell Publishing Group.
- DePorter, B., Reardon, M., & Singer-Nourie, S. (1998). *Quantum teaching: orchestrating student success*. Allyn and Bacon.
- Ekici, G. (2019). Kuantum öğrenme yaklaşımı [Quantum learning approach]. In G. Ekici, & M. Güven (Eds.), *Yeni öğrenme- öğretmen yaklaşımları ve uygulama örnekleri [New learning-teacher approaches and application examples]* (p. 404-436). Pegem Academy Publication.
- Fenar, A. (2021). *A mixed method research on teaching the 6th grade social studies course according to the quantum learning model* (Master's dissertation). Anadolu University, Institute of Educational Sciences, Türkiye.
- Given, B. K., & DePorter, B. (2015). *Excellence in teaching and learning: The quantum learning system*. Learning Forum Publications.
- Güllü, A. (2010). *The effect of the quantum learning model on student success at the secondary education level (Konya Example)* (Master's dissertation). Selçuk University, Institute of Educational Sciences, Türkiye.
- Hinton, L., Simpson, G., & Smith, D. (2008). Increasing selfefficacy beliefs in middle school students using quantum learning techniques. Paper published by *Educational Specialist Candidates Piedmont College*. <https://quantumlearning.com/education-research-downloads/>
- Khozaei, S. A., Zare, N. V., Moneghi, H. K., & et al. (2022). Effects of quantum-learning and conventional teaching methods on learning achievement, motivation to learn, and retention among nursing students during critical care nursing education. *Smart Learning Environments*, 9(1), 18. <https://doi.org/10.1186/s40561-022-00198-7>
- Le Tellier, J. P. (2006). *Quantum learning & instructional leadership in practice*. Corwin Press.
- Nahar, S. (2022). Improving students' collaboration thinking skill under the implementation of the quantum teaching model. *International Journal of Instruction*, 15(3), 451-464. <https://doi.org/10.29333/iji.2022.15325a>
- Suryani, N. (2013). Improvement of students' history learning competence through quantum learning model at senior high school in Karanganyar Regency, Solo, Central Java Province, Indonesia. *Journal of Education and Practice*, 4(14), 55-63. <https://iiste.org/Journals/index.php/JEP/article/view/6798>
- Sujatmika, S., Hasanah, D., & Hakim, L. L. (2018). Effect of quantum learning model in improving creativity and memory. *International Conference on Science Education (ICoSEd)*, (Vol. 1006, No. 1, p. 012036). IOP Publishing. <https://doi.org/10.1088/1742-6596/1006/1/012036>
- Şerefli, B. (2020). *Flipped classroom model in teaching social studies: Its effect on academic success, attitude and student views* (Master's dissertation). Gazi University, Institute of Educational Sciences, Türkiye.
- Şimşek, F. (2016). *The effect of quantum learning model on students' academic achievement, attitude towards science and technology course, motivation and retention of knowledge in science and technology course* (Master's dissertation). Kahramanmaraş Sütçü İmam University, Institute of Science, Türkiye
- Şöhretli, G. (2014). *The effect of quantum learning model on the academic achievement, science process skills and attitudes towards mathematics of 4th grade primary school students* (Master's dissertation). Hatay Mustafa Kemal University, Institute of Educational Sciences, Türkiye.
- Tabachnick, B. G., & Fidell, L. S. (2019). *Using multivariate statistics*. Pearson.
- Trice, T.Y. (2012). *Quantum learning making prodigious strides in education* (PhD dissertation) Trevece Nazarane University, Scohol of Education, Türkiye.
- Ünal, A. İ. (2019). *The effect of the quantum learning model on the social studies course achievement, anxiety, metacognitive awareness and academic risk/taking tendencies of secondary school 7th grade students* (Master's dissertation). Uşak University, Institute of Social Sciences, Türkiye.
- Whitworth, S. A., & Berson, M. J. (2003). Computer technology in the social studies: An examination of the effectiveness literature (1996-2001). *Contemporary Issues in Technology and Teacher Education*, 2(4), 472-509. <https://citejournal.org/volume-2/issue-4-02/social-studies/computer-technology-in-the-social-studies-an-examination-of-the-effectiveness-literature-1996-2001/>



| Research Article / Araştırma Makalesi |

Investigation of University Students' Smartphone Security Measures Behaviors

Üniversite Öğrencilerinin Akıllı Telefon Güvenlik Önlemleri Davranışlarının İncelenmesi

Vildan ATEŞ¹

Keywords

1. Smartphone
2. Security
3. Security measure behaviours
4. University students

Anahtar Kelimeler

1. Akıllı telefon
2. Güvenlik
3. Güvenlik önlemleri davranışları
4. Üniversite öğrencileri

Received/Başvuru Tarihi
10.12.2024

Accepted / Kabul Tarihi
25.07.2025

Abstract

Purpose: This study aims to investigate the security measure behaviours of the 18-24 age group, which constitutes the majority of smartphone users, while using smartphones. In this study, in contrast to other studies, security measures and behaviours were examined through three approaches: protection by smartphone settings and add-on utilities, protection by avoiding harmful behaviours and applications, and protection by preventive behaviours and applications.

Design/Methodology/Approach: This research employs a quantitative methodology. One of the survey models used was the descriptive survey model. The data for this study were collected from 320 university students enrolled at four state universities in Ankara (Ankara University, Ankara Yıldırım Beyazıt University, Gazi University, and Middle East Technical University) during the fall term of the 2024-2025 academic year. The data collection tool for this study is a questionnaire comprising three sections. The questionnaire includes questions to collect demographic information and items for 17 smartphone security behaviours, presented in three categories. IBM SPSS 30.0 was used for data analysis. Data analysis obtained in this study, frequency, and percentage (%) from descriptive statistics were used.

Findings: The study's findings indicate that the Android operating system is the most dominant among smartphone users. The study revealed that users don't set their smartphones to remote data wipe in case of loss or theft, and that wireless connection areas are turned on when not in use. It was observed that users retain their usernames and passwords on their smartphones. Furthermore, the respondents indicated that they don't utilize antivirus or security software on their phones and create backup copies of their data. It was noted that users don't review license agreements or security messages when installing or using a new application. Conversely, users employ encryption and screen locks to safeguard the data on their devices. Users refrain from installing illegal or unauthorized software on their smartphones and don't download attachments from unknown email addresses using their smartphones.

Highlights: Users need training and support on how to protect their smartphones with preventive behaviours and applications. They also need to be informed about phone settings and add-on utilities. On the other hand, users have appropriate security behaviours to protect their smartphones by avoiding harmful behaviours and applications.

Öz

Çalışmanın amacı: Bu çalışmanın amacı akıllı telefon kullanıcılarının önemli yüzdesini oluşturan 18-24 yaş grubunun akıllı telefon kullanırken gösterdikleri güvenlik önlemleri davranışlarını ortaya çıkarmaktır. Bu çalışmada diğer çalışmalardan farklı olarak güvenlik önlemleri davranışları akıllı telefon ayarları ve eklenti yardımcı programları ile koruma, zararlı davranış ve uygulamalardan kaçınarak koruma ve önleyici davranış ve uygulamalar ile koruma olmak üzere üç yaklaşımla incelenmiştir.

Materyal ve Yöntem: Bu araştırmanın yöntemi nicel araştırmadır. Tarama modellerinden biri olan betimsel tarama modeli kullanılmıştır. Araştırmanın verileri Ankara'daki dört devlet üniversitesinde (Ankara Üniversitesi, Ankara Yıldırım Beyazıt Üniversitesi, Gazi Üniversitesi ve Orta Doğu Teknik Üniversitesi) 2024-2025 öğretim yılı güz döneminde öğrenim gören 320 üniversite öğrencisinden toplanmıştır. Bu çalışmanın veri toplama aracı üç bölümden oluşan ankettir. Ankette demografik bilgileri toplamaya yönelik sorular ile üç yaklaşım ile düzenlenmiş 17 akıllı telefon güvenlik davranışı için maddeler bulunmaktadır. Verilerin analizi için IBM SPSS 30.0 programı kullanılmıştır. Bu çalışmada elde edilen verilerin analizinde betimsel istatistiklerden sıklık (frekans) ve yüzde (%) kullanılmıştır.

Bulgular: Bu çalışma sonucunda Android'in, kullanıcıların akıllı telefonlarında kullandıkları en popüler işletim sistemi olduğu görülmüştür. Çalışmada kullanıcıların akıllı telefonlarının kaybolması veya çalınması durumunda uzaktan veri silme işlemine ayarlı olmadığı ve kullanmadıkları zamanlarda kablosuz bağlantı alanlarının açık olduğu görülmüştür. Kullanıcılar akıllı telefonlarında kullanıcı adlarını ve şifrelerini akıllı telefonlarında saklamaktadır. Ayrıca antivirüs ya da güvenlik yazılımları telefonlarında yüklü olmayıp telefonlarının yedek kopyasını da almadıklarını belirtmişlerdir. Kullanıcıların akıllı telefonlarına yeni bir uygulama yüklerken veya kullanırken lisans sözleşmelerini ve güvenlik mesajlarını okumadıkları da görülmüştür. Diğer taraftan kullanıcılar telefonlarındaki verileri korumak için şifreleme ve ekran kilidi kullanmaktadırlar. Kullanıcılar akıllı telefonlarına yasadışı veya izinsiz yazılım yüklemekte ve akıllı telefonları ile bilinmeyen e-postalardaki ekleri de indirmemektedirler.

Önemli Vurgular: Kullanıcıların önleyici davranış ve uygulamalar ile akıllı telefonlarını nasıl koruyacakları konusunda eğitim ve desteğe ihtiyaçları olduğu görülmüştür. Aynı şekilde telefon ayarları ve eklenti yardımcı programları hakkında da bilgilendirilmeleri gerekmektedir. Diğer taraftan kullanıcılar zararlı davranış ve uygulamalardan kaçınarak akıllı telefonlarını korumaya yönelik güvenlik davranışları uygun biçimdedir.

¹ **Corresponded Author**, Ankara Yıldırım Beyazıt University Business School Department of Management Information Systems, Ankara Yıldırım Beyazıt University, Ankara, Türkiye; <https://orcid.org/0000-0002-8855-8556>

INTRODUCTION

Mobile technologies have led to the emergence of a new type of device, the programable mobile phone or smartphone. The smartphone is a radical device that has features that are not traditionally associated with phones, such as an operating system, web browsing, and the ability to run software applications and integrates a computer that can simplify any task with just a few clicks. Moreover, smartphones combine an integrated computer and a mixture of other features that make them exceptionally capable, such as web browsing and operating systems.

Users are increasingly storing personal information, such as transactions on e-commerce, finance, and social media platforms, on smartphones. Attackers have primarily focused on mobile applications over the past decade (Alkindi, Sarrah, and Alzeidi, 2021). The first mobile malware, Cabir, was discovered in the Symbian mobile operating system in 2004. Since then, there has been a steady increase in the amount of malware in the mobile market (Goni et al., 2021).

Since 2008, the smartphone industry has been steadily growing and expanding in terms of market size, number of models, and vendors. By the end of 2023, nearly 70% of the world's population was smartphone users (Laricchia, 2024). In the top 10 more developed countries, about three-quarters of the population own a smartphone, and globally, nearly 90% of mobile phones are smartphones. The unprecedented growth in demand for the smartphone market over the past decade has paved the way for increased use of smartphones for personal and official communication, gaming, and online shopping. Additionally, approximately 92.3% of internet users access the internet using a mobile phone (Howarth, 2024). There are over 7.2 billion smartphones worldwide, and it is expected to grow in the future. The smartphone market also grows significantly, by 7.8%, in the first quarter of 2024 (Howarth, 2024). In Turkey, the number of smartphone users has also been increasing, exceeding 80 million as of 2023, and is expected to reach approximately 88 million by 2028 (Dierks, 2023).

Smartphones have become an indispensable part of modern life. Users can program any customized application to suit their needs and share these applications online. Therefore, smartphones and related applications have become the most popular keywords in mobile technology. The mobility, portability, and increasing smartphone capabilities have significantly contributed to the increasing popularity of multipurpose devices. As smartphones begin to replace personal computers due to their advanced features and ease of use, most users' sensitive data, including emails, photos, and videos, are now stored and processed on smartphones. For example, during the COVID-19 pandemic, smartphones and other mobile devices were routinely used for data storage and interactions, including in healthcare (Farshidfar & Hamedani, 2020; Ganesh et al., 2020; Sansom-Daly & Bradford, 2020) and telehealth services (Chin, Jones & Little, 2021).

While cyberattacks have traditionally been primarily targeted at computers and servers, smartphones have increasingly become the target of cybercriminals who seek to steal personal or corporate data. The increase in the functionality and adoption of smartphones has made these devices attractive targets for cybercriminals. The device and the vast amount of information contained constitute a valuable target for attack (Parker et al., 2015). The increase in remote work, especially during the COVID-19 pandemic, the use of smartphones to access company systems and software, and the growth in mobile commerce have led to a significant increase in threats. These activities using smartphones have allowed cybercriminals to gain access to smart devices (Wasserman, 2022). Considering the rapidly increasing storage capacity of devices and the ability to store more personal data (such as photos and videos), the threat of data theft is also increasing (Allam, Flowerday & Flowerday, 2014). In addition, targeted theft of data stored on or shared online through smartphones is a concern (Chin, Jones & Little, 2021; Das & Khan, 2016). Therefore, smartphone users must implement security measures to protect against threats from potential criminals or user negligence (Parker et al., 2015).

Malware and data leakage are the most prominent threats faced by smartphone users. However, it has been observed that smartphone users have a habit of ignoring the security messages they receive (Mylonas, Kastania & Gritzalis, 2013). This is a security vulnerability that jeopardizes smartphone security. Additionally, users rarely consider privacy and security when downloading new applications and do not adequately protect themselves by implementing smartphone protection mechanisms (Ophoff & Robinson, 2014). This is true even for younger, tech-savvy generations who have early access to mobile devices. Studies on students have revealed that they do not pay significant attention to smartphone protection mechanisms (Park & Drevin, 2016).

The fundamental issue is that users are unaware that smartphones require the same security and protection as computers (Lawton, 2008). This primarily increases security concerns and reveals the need to understand whether smartphone users are aware of security issues related to smartphone use. In other words, understanding user behaviour related to information security in smartphone usage has become increasingly critical. Additionally, to establish an effective and secure mobile ecosystem, it is necessary to understand user behaviour related to smartphone security and privacy. This study aims to investigate the security measures behaviour of university students aged 18-24 in using smartphones.

The research question for this study is as follows:

- 1) What are the smartphone security measure behaviours of university students?

This study reveals the security measures behaviours of the 18-24 age group, which constitutes the largest percentage of smartphone owners. In addition, this study examines security measures behaviours through three different approaches, which is different from other studies. This study is expected to make valuable contributions to the Turkish literature by revealing the basic

security behaviours of smartphone users. Furthermore, the study is important because it will assess the awareness level of young people regarding smartphone security and identify areas that need to be focused on.

This study is organized into five sections. The first section introduces the research topic, providing essential background information and highlighting its significance, and research question. The second section offers a comprehensive literature review, summarizing key studies and identifying gaps this research aims to address. The third section details the research methodology, participants, data collection tool, and process employed. The fourth section presents the findings of the study. Finally, the fifth section concludes the study with a summary of the key insights and offers recommendations for future research and practical applications.

LITERATURE REVIEW

Smartphones have recently become a significant target for cybercriminals due to the large amount of sensitive data and user credentials stored on such devices (Knapova et al., 2021). Users can also apply various security behaviors to protect themselves from cyber threats. While smartphone companies offer various security tools such as encryption, firewalls, antivirus, and malware prevention that can lower the risk of security breaches in smartphone networks, multiple studies have shown that smartphone users do not adopt these Technologies (Egan et al., 2012; Lazou & Weir, 2011). Furthermore, an insecure smartphone device not only jeopardizes the security of personal data but can also put the company's information assets at risk. Therefore, employees using personal smartphones at work pose a greater risk to the company's information security (Egan et al., 2012).

A study by Androulidakis and Kandus (2011) that investigated mobile phone students' security awareness in Budapest showed that only 12.3% of users used antivirus software, and only 24.5% of students had a password on their phones. Similar results were also presented in a study by Ophoff (2014). Among the participants, 97% used security software on their computers, whereas only 27% used security software on their smartphones. The results also demonstrated that only half of the users who believed security software was necessary had it installed on their devices.

A study conducted in China also highlighted that security information is often ignored during the downloading and use of applications in smartphone usage, auxiliary programs are inappropriately enabled, and appropriate disaster recovery plans are lacking on smartphones, indicating serious concerns about information security (Zhang, Li, & Deng, 2017). Another study reported a lack of awareness among smartphone users about the security and privacy risks associated with downloaded smartphone applications. Most participants assumed controlled application marketplaces (e.g., Google Play) were secure. In addition, more than 65% of participants engaged in risky behavior by allowing free applications to access their data (Mylonas, Kastania, & Gritzalis, 2013). A related study revealed that although the majority of users had configured appropriate screen lock settings to prevent unauthorized physical access to their smartphones, they largely neglected other critical security practices, such as utilizing virtual private networks (VPNs) when accessing public Wi-Fi networks or disabling unused features on their devices (Breitinger, Tully-Doyle, & Hassenfeldt, 2020). A study conducted in India also examined the usage patterns of smartphone users and investigated whether general security concerns existed among such users. The most notable finding was that, despite possessing knowledge about various security threats, participants seldom implemented protective measures for their devices. Additionally, they appeared to lack awareness of technical security mechanisms such as data encryption and remote wipe functionalities (Shah & Agarwal, 2020). Another study in India reported a deep understanding of users' awareness regarding smartphone security. However, users are concerned about data stored on their smartphones because they believe smartphones are not as secure as computers. In addition, users reported installing pirated software on their smartphones rather than purchasing applications from official app stores (Bagga et al., 2017). A study conducted in Greece by Stylios et al. (2016) also demonstrated that although many smartphone users implemented some security measures, most users ignored security and privacy risks.

A study conducted in Turkey on this topic was conducted by Koyuncu and Pusatlı in 2019. This study investigated the awareness levels of smartphone users regarding different security parameters and compared the awareness levels of user groups categorized by demographic data (Koyuncu & Pusatlı, 2019). Another study examined university students' mobile application security awareness (Talan et al., 2015). In a more recent study, Erdoğan and Coşar (2024) investigated the cybersecurity awareness of teachers when installing a mobile application. The research results revealed that the awareness level of teachers regarding security vulnerabilities in mobile applications was 79.7% (Erdoğan & Coşar, 2024). In conclusion, studies reporting different results have been conducted in this area.

A review of the literature shows that recent research has largely focused on computer and cybersecurity threats (Abdullahi et al., 2022; Basholli, Mezini & Basholli, 2023; Dolan & Widayanti, 2022, Kaur & Ramkumar, 2022; Nadeem et al., 2023; Prakash, Anoop & Asharaf, 2022; Taherdoost, 2022). These studies have addressed technical topics such as blockchain, cloud computing, artificial intelligence, and machine learning. On the other hand, while increasing a user's knowledge can improve their compliance with security practices, educators need a complete understanding of users' current behaviours, misconceptions, and general attitudes toward smartphone security. In this study, the security measures behaviours of university students aged 18-24 in using smartphones will be examined under three approaches.

METHOD

This section presents the study's research method, participants, data collection tool, and data collection process.

Research Method

This study employed a quantitative research methodology. This study is descriptive research, and its model is a survey. The descriptive survey model was selected for two primary reasons. First, it enables collecting many participants, which is a significant advantage. Second, it allows for analyzing individuals' views and attitudes toward a phenomenon or event, along with the description of the phenomenon or event itself. In other words, this model provides the ability to explore different aspects of a topic and understand complex issues.

Participants

The study group for this research comprises university students aged 18-24. There are two reasons for selecting this age group. First, they are enthusiastic about and easily adopt smartphone technologies (Fidan, 2019; Jones & Chin, 2015). The second reason is that users in this age group comprise the largest percentage (48%) of smartphone owners (Pew Research Center, 2022). When selecting university students who will participate in the research, the convenience and criterion sampling methods, which are non-random sampling methods, were used. Convenience sampling was preferred because it provides access to participants who can contribute to the research quickly and easily. Criterion sampling was also used to ensure that participants who met the criteria for the study were selected. Criteria for this research are that the participants must be university students between 18 and 24 years old and have been using a smartphone for at least 1 year. The study's data was collected from 320 university students enrolled at four state universities in Ankara (Ankara University, Ankara Yıldırım Beyazıt University, Gazi University, and Middle East Technical University) during the fall semester of the 2024-2025 academic year.

Data Collection Tool

The data collection tool used in this study was a questionnaire consisting of three sections. The first section provides information about the purpose, importance, and details of the questionnaire to the participants. The second section includes five questions to collect participants' demographic information (gender, age, grade, university, faculty) and two questions to determine their smartphone operating system and the duration of their internet use. The third section contains items related to 17 smartphone security behaviors (Harris, Patten & Regan, 2013). The necessary permissions were obtained by emailing the researchers regarding the questionnaire items' usage. The draft questionnaire was submitted to the opinions of three experts, and the English-Turkish translations were checked. Then, the Turkish comprehensibility of the questionnaire items was sent to a field expert, and feedback from the experts was applied to finalize the questionnaire items. The pilot questionnaire test was conducted with five university students. Because of these processes, a final version of the questionnaire was created. The questionnaire contains 24 questions.

The questionnaire items were organized according to three approaches proposed by Jones and Heinrichs (2012). These approaches include protection through smartphone settings and auxiliary applications, avoidance of harmful behaviors and applications, and protection through preventive behaviors and applications. Participants were asked to select the most appropriate option (always, often, sometimes, rarely, and never) for each behavior. These three approaches and the recommended security behaviors for smartphones are summarized in Table 1.

Table 1. Approaches and recommended security behaviours for smartphones

Approach	Code	Security Behaviours
Protection with phone settings and add-on utilities	PP1	My smartphone is set up for remote data wipes in case of loss or theft.
	PP2	I use encryption to protect data on my smartphone.
	PP3	The Bluetooth on my smartphone is turned on when not in use.
	PP4	I use a screen lock on my smartphone.
	PP5	My smartphone's wireless connection (Wi-Fi) is turned on when not in use.
Avoiding of harmful behaviours and applications	AH1	I install illegal or unauthorized software on my smartphone.
	AH2	I install software from trusted sources on my smartphone.
	AH3	I connect my smartphone to an unsecured free wireless network (Wi-Fi).
	AH4	I avoid clicking on unknown links on my smartphone.
	AH5	I download attachments from unknown emails on my smartphone.
Protection through preventive behaviours and applications	PB1	I promptly install software updates on my smartphone.
	PB2	I store my usernames and passwords on my smartphone.
	PB3	I always read license agreements when installing a new application on my smartphone.
	PB4	I always read security messages when installing or using an application on my smartphone.
	PB5	I create backup copies of the data on my smartphone.
	PB6	I have antivirus protection installed on my smartphone.
	PB7	I have firewall software installed to protect my smartphone.

As shown in Table 1, a total of 17 recommended security behaviors are categorized under three smartphone usage approaches. These behaviors are widely recognized as fundamental practices for mitigating potential information security risks faced by smartphone users.

Data Collection

Before data collection, approval was obtained from the Ankara Yıldırım Beyazıt University's Social and Humanities Ethics Committee (dated November 22, 2023, and numbered 09-216) confirming that the study was ethically appropriate. Participants were provided with two options for participation: digital or in print format. The digital version of the data collection tool was prepared using Google Forms. 320 students participated in the study, 194 completed the digital version, and 126 preferred the printed format. The researcher conducted data collection between September 22 and October 23, 2024.

Data Analysis

The IBM SPSS Statistics 30.0 software was used for data analysis. Descriptive analysis was used to analyze data. Descriptive analysis summarizes data clearly and concisely, enabling researchers to understand the dataset's patterns, trends, and distributions and gain insights. Descriptive analysis was preferred because the dataset provides basic information about the variables and describes the distribution of each variable related to smartphone users' behaviors (Worgotter, 2011). Data analysis obtained in this study, frequency, and percentage values (%) were used, indicating how often the data occurred.

FINDINGS

This section comprises two subsections. The first subsection presents the participants' demographic information, including gender, age, grade, university, and faculty, along with findings related to smartphone operating systems and daily smartphone usage times. The second subsection presents the descriptive analyses of the data collected on the 17 smartphone security behaviours of the participants.

Demographic Information About the Participants

Participants' demographic information regarding age, university, faculty, and grade is presented in Table 2.

Table 2. Participants demographic information

Age	Frequency	%	Faculty	Frequency	%
18-20	131	41	Business	207	64
21-23	144	45	Education	105	33
24-26	45	14	Arts	8	3
University	Frequency	%	Study year	Frequency	%
Ankara	92	29	First-year	38	12
Ankara Yıldırım Beyazıt	115	36	Second-year	66	21
Gazi	105	32	Third-year	81	25
Middle East Technical	8	3	Fourth-year	135	42

A review of the participants' gender data revealed that 214 participants were female and 106 were male. When Table 2 is analyzed, it is also seen that most participants (86%) are between 18 and 23 years old. When the university distribution of the participants is examined, there are almost equal proportions of participants from the three state universities, while only 8 participants are from METU. In the same direction, most participants (64%) were business administration faculty students, and the remaining participants (33%) were education faculty students. Additionally, an analysis of the participants' study years revealed that most of them (67%) were in their third or fourth year of study. The participants were asked about the operating system that they used on their smartphones. Android was the most popular operating system (OS) (181 participants, 58%) used on the participants' smartphones. The second most used operating system was Apple iOS, with 131 participants (41%). It was observed that only two participants utilized disparate operating systems. One participant reported using Windows Mobile, while the other participant used Harmony. The final question asked the participants in this section concerned their daily smartphone usage. The responses to this question are presented in Table 3.

Table 3. Daily smartphone usage

Duration (hour)	Frequency	%
0-1	3	1
1-2	10	3
2-3	41	13
3-4	82	26
4-5	80	25
5-6	67	21
More than 6	37	11
Toplam	320	100

Table 3 illustrates that 162 participants (51%) used their smartphones for between 3 and 5 hours per day, and 104 participants (32%) engaged for more than five hours daily.

Findings on Participants' Smartphone Security Behaviours

In this subsection, the security behavior questions related to smartphone security are grouped and presented according to the three approaches (protection through smartphone settings and add-on utilities, avoidance of harmful behaviours and applications, and protection through preventive behaviours and applications). The frequency and percentage values obtained for each security behavior are also provided.

The first approach is to protect smartphones through phone settings and add-on utilities and includes five security behaviours. Table 4 presents these five security behaviours and the frequency and percentage values of the participant responses to each behavior.

Table 4. Frequency and percentage values of participants' security behaviours with phone settings and add-on utilities

Security Behaviour	Never	Rarely	Sometimes	Often	Always
My smartphone is set up for remote data wipes in case of loss or theft.	145 %45	54 %17	36 %11	26 %8	59 %19
I use encryption to protect data on my smartphone.	10 %3	16 %5	26 %8	71 %22	196 %62
The Bluetooth on my smartphone is turned on when not in use.	120 %38	69 %21	38 %12	44 %14	49 %15
I use a screen lock on my smartphone.	10 %3	3 %1	14 %4	32 %10	261 %82
My smartphone's wireless connection (Wi-Fi) is turned on when not in use.	60 %19	50 %16	52 %16	71 %22	87 %27

Table 4 reveals that 62% of participants didn't enable remote data wipes in the event of smartphone loss or theft. On the other hand, another security behavior with the same percentage was that the participants used encryption to protect the data on their smartphones. The majority of respondents (82%) also use a screen lock. When not in use, 38% of the participants had their Bluetooth turned off on their smartphones, while 49% of participants often or always had their wireless connection turned on.

The second approach involves protecting smartphones by avoiding harmful behaviours and applications. In this approach, the participants were asked about five security behaviours. Their responses are presented in Table 5.

Table 5. Frequency and percentage values of participants' security behaviours by avoiding harmful behaviours and applications

Security Behaviour	Never	Rarely	Sometimes	Often	Always
I install illegal or unauthorized software on my smartphone.	219 %68	48 %15	29 %9	16 %5	8 %3
I install software from trusted sources on my smartphone.	35 %11	19 %6	39 %12	126 %39	101 %32
I connect my smartphone to unsecured free wireless networks (Wi-Fi).	104 %33	69 %22	80 %25	42 %13	25 %7
I avoid clicking on unknown links on my smartphone.	5 %2	21 %7	31 %10	89 %27	174 %54
I download attachments from unknown emails on my smartphone.	172 %54	70 %22	34 %10	15 %5	29 %9

As shown in Table 5, most participants (68%) did not install illegal or unauthorized software on their smartphones. Consistent with this finding, most participants (71%) installed software from trusted sources. It was observed that 55% of the participants never or rarely connected to unsecured wireless networks, whereas 25% sometimes did. In contrast, 20% of them frequently connect or always. Table 5 shows that most participants (81%) often or always avoid clicking on unknown links. Similarly, half of the participants stated that they didn't download attachments from unknown emails using their smartphones.

Table 6. Frequency and percentage values of participants' security behaviours with preventive behaviours and applications

Security Behaviour	Never	Rarely	Sometimes	Often	Always
I promptly install software updates on my smartphone.	11 %3	39 %12	101 %32	98 %31	71 %22
I store my usernames and passwords on my smartphone.	45 %14	52 %16	79 %25	74 %23	70 %22
I always read license agreements when installing a new application on my smartphone.	123 %38	89 %28	66 %21	25 %8	17 %5
I always read security messages when installing or using an application on my smartphone.	55 %18	81 %25	81 %25	61 %19	42 %13
I create backup copies of the data on my smartphone.	24 %7	61 %19	101 %32	81 %25	53 %17
I have antivirus protection installed on my smartphone.	87 %27	61 %19	56 %18	49 %15	67 %21
I have firewall software installed to protect my smartphone.	83 %26	71 %22	53 %17	51 %16	62 %19

In this section, the initial security behavior is the on-time installation of software updates. 32% of participants indicated that they occasionally install software updates on time, whereas 53% of participants stated that they frequently or consistently install software updates on their smartphones on time. Furthermore, 45% of the participants stored their usernames and passwords on their smartphones. The remaining two security behaviors pertain to the antivirus and security software installed on the respondents' smartphones. It was noted that 46% of participants didn't have an antivirus program installed on their smartphones. In a similar proportion, 48% of participants indicated that they didn't install firewall software on their smartphones. As shown in Table 6, only 21% of participants had antivirus software installed, while 19% had firewall software installed. Additionally, only 17% of participants regularly created backup copies of the data on their smartphones.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This study presents the security measures observed in the smartphone usage behaviors of Turkish university students aged 18 to 24. In contrast to existing studies, this study classified 17 security behaviours under three approaches to examine.

The results of this study indicate that Android is the most prevalent operating system among the participants in terms of smartphone use. In addition, the study revealed that users don't read license agreements when installing new applications on their smartphones and do not read security messages when installing or using an application. On the other hand, the open-source nature of the Android platform allows developers to modify software, creating innovative and new applications. Additionally, developers can quickly bring apps to market with the help of the platform's readily available tools and efficient review process. However, users should still act with caution and carefully assess the developer's background. Furthermore, they should perform a detailed review of the application to ensure appropriateness, adherence to software development standards, and the absence of malicious code. In addition, Android users have access to numerous markets with disparate levels of security, which can present significant security risks without comprehensive awareness and training. It is recommended that users download apps from official channels, such as the Apple App Store, Google Play, and Amazon App Store. Although applications on these marketplaces are not 100% secure, they undergo a degree of screening and are filtered. Users should examine the applications' permissions they use and exercise caution before granting access, particularly when it comes to high-risk permissions, such as accessibility services.

Another challenge with the Android platform is the large number of operators and vendors that do not adopt a consistent standard, which results in the continued availability of the operating system's older versions. On the other hand, 41% of respondents indicated that they use Apple's iOS. In contrast to the Android operating system, the Apple iOS is a closed operating system managed by Apple. Only one manufacturer produces devices for the platform, and there is no OS fragmentation (Mansfield-Devine, 2012). Updating these devices is straightforward and encouraged by Apple, which is one reason why the operating systems of Apple devices are more up-to-date than those of Android devices, providing a higher level of security. It is important to note that there has been an increase in the incidence of advanced persistent threats (APT), side-channel attacks, sensor-based attacks, and attacks launched through the Google Play Store (Muhammed et al., 2023).

In the initial approach, an investigation was conducted into the security behaviours exhibited by users to safeguard their smartphones, with a specific focus on the use of phone settings and additional utilities. Upon examination of these behaviors, we found that users employed encryption and screen locks to safeguard data stored on their smartphones. It can be concluded that they demonstrate a high level of awareness regarding these two behaviors. Another encouraging observation is that most users disable Bluetooth on their smartphones when they are not in use. It is also noteworthy that two behaviours were observed that could compromise the security of the devices. The wireless connections were left enabled when the devices were not in use, and remote data wiping was not employed in the event of a lost or stolen smartphone. To prevent unintended connections to unsecured public wireless networks, users are recommended to disable the auto-join function and to connect only to secure wireless networks. In addition, users should avoid financial transactions or accessing social network accounts on insecure networks via public wireless connections. In addition, the most effective way to protect credentials (passwords, credit card details, etc.) is to enter them only on a secure network. It is also recommended to enable a firewall on a user's smartphone. Although a firewall is not a prerequisite for a secure connection, its activation when a public wireless network is used provides a crucial layer of protection against cyber threats. If a device is lost or stolen, data-wiping software can be used to delete sensitive data from the device. This deletes all personal information and eliminates the risk of data access, thus helping to minimize the risk of data theft. However, users should assume that all smartphone data has been leaked and take appropriate reactive measures.

The second approach examined user security behaviors to protect smartphones by avoiding harmful behaviors and applications. It is found that users did not install illegal or unauthorized software on their smartphones. Instead, they install software from trusted sources. Similarly, it can be concluded that users never connect to unsecured wireless networks. They also avoid clicking on unknown links on their smartphones. Furthermore, the participants did not download attachments from unknown emails using their smartphones. It is recommended that smartphone users avoid connecting to free wireless networks whenever possible. Furthermore, once connected, it is crucial to avoid performing financial transactions without a virtual private network (VPN). The five security behaviours described in this approach were observed to be performed appropriately by the users. It was observed that all five security behaviours in this approach were performed appropriately by the users. It was determined that users have a positive attitude toward this approach regarding these security behaviours.

The third approach is users' security behaviors in protecting their smartphones through preventive behaviors and applications. Initially, it was observed that users install software updates for their smartphones on time. The operating system and crucial applications must be updated immediately as new updates become available for the smartphone. It is also noteworthy that installing the latest software version can fix most security issues. It has been observed that users do not read license agreements when installing a new application on their smartphones and do not read security messages when installing or using an application. Users neglect to read license agreements or messages during the app installation process and are unaware of the terms and conditions to which they agree. However, some applications can affect user privacy, request the installation of other apps, or even change a device's OS settings, and such actions must be performed legally. The results of a survey conducted by Kaspersky revealed that nearly half of the respondents may be at risk due to the applications installed on their mobile devices. This is because users are not sufficiently knowledgeable about cybersecurity to restrict the permissions granted to applications during installation. A total of 15% of respondents indicated that they never limited the capabilities of applications installed on their mobile devices. In addition, 17% of respondents reported that they granted permissions to applications when prompted and subsequently forgot to alter these permissions. Furthermore, 11% of respondents believed they could not modify these permissions. Without restrictions on application permissions, apps can access personal and private data on mobile devices, including contact information, photos, and location data (Kanali, 2016). Therefore, it is crucial to read the license agreement when installing software. The list of permissions requested by an application should be carefully reviewed, and installation should not proceed without checking and understanding what is accepted during installation.

Another behavior in this approach is that users store usernames and passwords on their smartphones. The main risk associated with storing usernames and passwords in notes is that unwanted parties can access this information. In general, writing down passwords anywhere, especially on a cell phone, can compromise the security and privacy of such accounts. Usernames and passwords are the keys to digital life. They protect personal and professional data, online accounts, and user identities. Therefore, it is advisable to use a password manager. A password manager is an application that securely stores and encrypts your passwords and automatically fills them in when you log in to a website or application.

The other two security behaviours in this section were associated with the antivirus and security software installed on the participants' smartphones. Almost half of the users did not install antivirus or firewall software on their smartphones. Harris, Patten, and Regan (2013) also highlighted in their study of university students that only 27% of users had antivirus software installed on their smartphones. Android operating systems are more susceptible to malware infections. One antivirus company estimates that over 4% of Android devices are infected with malware (Troung et al., 2014). Kaspersky reported a consistent increase in the number of attacks on mobile devices in 2023, reaching almost 33.8 million attacks, representing a 50% increase

compared to the previous year's figures (Kaspersky, 2024). A further study was conducted in the United States with 2337 participants, the findings of which indicated that 70% of smartphone owners believed their devices to be secure from hackers, malware, and other forms of cybercrime (InfoSecurity, 2012). Despite the robust security measures inherent to mobile operating systems such as Android and iOS, these platforms remain susceptible to potential threats. Antivirus applications provide an additional layer of protection against malware, phishing attacks, and other cyber threats that have the potential to compromise personal data, privacy, and device performance. Moreover, as the prevalence of mobile devices continues to grow, so too does the number of individuals targeted by hackers. Anti-virus applications can scan for suspicious activity, block malicious websites, and assist users in locating lost or stolen phones. The installation of security software provides users with a valuable layer of protection, thereby enhancing the overall security and stability of their mobile experience. In addition, previous studies have revealed that most users do not create backup copies of data stored on their smartphones. As smartphones are becoming as powerful as computers, it is critical to apply the same security principles to computer-related devices. Therefore, users aged 18-24 should be more aware of smartphone device security. In addition, malware has become the most significant threat to smartphones. Therefore, a device must be up-to-date and protected against malware attacks.

The results of this study are important for businesses because these students may have already joined the workforce with their smartphones or will do so shortly. As these devices will connect to corporate networks, companies must consider them as part of their network. Security awareness and training should cover mobile devices such as smartphones, PCs, and other security threats to the organization. In addition, smartphones have increased so rapidly that many people do not know how to properly secure such devices, as evidenced by the university students who participated in this study. One solution to this problem is for businesses to create smartphone security awareness and training and provide it to all new and existing employees at least annually. Such training would inform users about free or inexpensive antivirus, firewall, and data-wiping software. Users will also be informed about malware and third-party marketplaces. Although smartphone security awareness and training are only one part of maximizing information security, it has become too important to ignore.

It should be noted that the study was conducted with a limited sample size, comprising students from only three state universities. This may be considered a potential limitation of the study. A further limitation is that the study focuses on only 17 security behaviors at the basic level. In future studies, researchers could consider conducting interviews with different age groups. In addition, the number of safety behaviors could be increased. Studies can be carried out with private university students in private universities to make comparisons with the results of this study.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author received no financial support for the research, author-ship, and/or publication of this article.

Statements of publication ethics

I hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Author contributions

V.A. conceived the research idea by reviewing the literature and developing the research question, collected the data. V.A. analyzed the data organized the manuscript and wrote the final manuscript.

Ethics Committee Approval Information

The study's approval was obtained from the Social and Humanities Ethics Committee of Ankara Yıldırım Beyazıt University (dated November 22, 2023, and numbered 09-216) confirming that the study was ethically appropriate.

REFERENCES

- Allam, S., Flowerday, S. V., & Flowerday, E. (2014). Smartphone information security awareness: A victim of operational pressures. *Computers & Security*, 42, 56-65.
- Androulidakis, I., & Kandus, G. (2011). Mobile phone brand categorization vs. users' security practices. *Engineering, Technology & Applied Science Research*, 1(2), 30-35.
- Alkindi, Z.R., Sarrab, M. and Alzeidi, N. (2021). User privacy and data flow control for android apps: a systematic literature review. *Journal of Cyber Security and Mobility*, 10, 261-304. <https://doi.org/10.13052/jcsm2245-1439.1019>.
- Bagga, T., Sodhi, J., Shukla, B., & Qazi, M. (2017). Smartphone security behaviour of the Indian smartphone user. *Man In India*, 97(24), 333-344.

- Breitinger, F., Tully-Doyle, R., & Hassenfeldt, C. (2020). A survey on smartphone user's security choices, awareness and education. *Computers & Security*, 88, 101647.
- Chin, A., Jones, B., & Little, P. (2021). A comparative analysis of smartphone security behaviours and practices. *International Journal of Education and Development using Information and Communication Technology*, 17(3), 57-80.
- Das, A., & Khan, H. U. (2016). Security behaviours of smartphone users. *Information & Computer Security*, 24(1), 116-134.
- Dierks, Z. (2023). Forecast of the smartphone user penetration rate in Turkey 2018-2024. <https://www.statista.com/statistics/568281/predicted-smartphone-user-penetration-rate-in-turkey/#:~:text=Smartphone%20usage%20in%20Turkey,million%20smartphone%20users%20in%20Turkey>, Erişim Tarihi: 07.11.2024.
- Egan, G., Haley, K., McKinney, D., Millington, T., Mulcahy, J., Parsons, T., ... Hittel, S. (2012). *Internet security threat report*. Technical Report. April.
- ENISA: European Union Agency for Network and Information Security (2010). Smartphone security: information security risks, opportunities and recommendations for users. http://www.enisa.europa.eu/activities/identity-and-trust/risks-and-data-breaches/smartphones-information-security-risks-opportunities-and-recommendations-for-users/at_download/fullReport, Erişim Tarihi: 10.11.2024.
- Erdoğan, E., & Coşar, M. (2024). Akıllı telefon uygulamalarının kullanıcı bazlı siber güvenlik farkındalığı. *Journal of Management Theory and Practices Research*, 5(1), 15-33.
- Farshidfar, N., & Hamedani, S. (2020). The potential role of smartphone-based microfluidic systems for rapid detection of COVID-19 using saliva specimen. *Molecular Diagnosis & Therapy*, 24(4), 371-373.
- FCC: Federal Communications Commission (2015). FCC Smartphone security checker. <https://www.fcc.gov/smartphone-security>, Erişim Tarihi: 15.11.2024.
- Fidan, M. (2019). Development of a scale for university students Facebook use purposes and an examination in terms of their Facebook use profiles. *International Journal of Education and Development using Information and Communication Technology*, 15(4), 132-150.
- Ganesh, A., Sahu, P., Nair, S., & Chand, P. (2020). A smartphone-based e-consult in addiction medicine: An initiative in COVID lockdown. *Asian Journal of Psychiatry*, 51, 102120.
- Goni, I., Gumpy, J.M., Maigari, T.U. & Mohammad, M. (2020). Cybersecurity and cyber forensics: machine learning approach systematic review. *Semiconductor Science and Information Devices*, 2, 25-29. <https://doi.org/10.30564/ssid.v2i2.2495>.
- Harris, M. A., Patten, K., & Regan, E. (2013). *The need for BYOD mobile device security awareness and training*. Proceedings of the Nineteenth Americas Conference on Information Systems, Chicago, Illinois, USA.
- He, W. (2013). A survey of security risks of mobile social media through blog mining and an extensive literature search. *Information Management & Computer Security*, 21(5), 381-400.
- Howarth, J. (2024). How Many People Own Smartphones? (2024-2029). <https://explodingtopics.com/blog/smartphone-stats>, Erişim Tarihi: 10.11.2024.
- InfoSecurity, 2012. Most users have not installed security software on their smartphones, survey finds. <https://www.infosecurity-magazine.com/news/most-users-have-not-installed-security-software/>, Erişim Tarihi: 15.11.2024.
- Jones, B. H., & Chin, A. G. (2015). On the efficacy of smartphone security: A critical analysis of modifications in business students' practices over time. *International Journal of Information Management*, 35(5), 561-571.
- Jones, B. H., & Heinrichs, L. R. (2012). Do business students practice smartphone security? *Journal of Computer Information Systems*, 53, (2), 22-30.
- Kanali, N. (2016). 63% of consumers globally don't license agreement when installing new apps on their devices. <https://techtrendske.co.ke/2016/05/05/63-of-consumers-globally-dont-license-agreement-when-installing-new-apps-on-their-devices/>, Erişim Tarihi: 20.11.2024.
- Kaspersky. (2024). Attacks on mobile devices significantly increase in 2023. <https://www.kaspersky.com/about/press-releases/attacks-on-mobile-devices-significantly-increase-in-2023>, Erişim Tarihi: 20.11.2024.
- Kim, H. (2017). Statistical notes for clinical researchers: Chi-squared test and Fisher's exact test. *Restorative Dentistry & Endodontics*, 42, 152-155.
- Koyuncu, M., & Pusatli, T. (2019). Security awareness level of smartphone users: An exploratory case study. *Mobile Information Systems*, 1-11.
- Knapova, L., Kruzikova, A., Dedkova, L., & Smahel, D. (2021). Who Is smart with their smartphones? Determinants of smartphone security behaviour. *Cyberpsychology, Behaviour, and Social Networking*, 24(9), 584-592.
- Laricchia, F. (2024). Smartphones - statistics & facts. <https://www.statista.com/topics/840/smartphones/#topicOverview>, Erişim Tarihi: 20.11.2024.
- Lawton, G. (2008). Is it finally time to worry about mobile malware? *Computer*, 41(5):1214.
- Lazou, A., & Weir, G. R. (2011). Perceived risk and sensitive data on mobile devices. *Cyberforensics: Issue and Perspectives*, 183-196.
- Mansfield-Devine, S. (2012). Paranoid Android: just how insecure is the most popular mobile platform? *Network Security*, 2012(9), 5-10.
- Markelj, B., & Bernik, I. (2015). Safe use of mobile devices arises from knowing the threats. *Journal Of Information Security And Applications*, 20, 84-89.
- Muhammad, Z., Anwar, Z., Javed, A. R., Saleem, B., Abbas, S., & Gadekallu, T. R. (2023). Smartphone security and privacy: a survey on apts, sensor-based attacks, side-channel attacks, Google Play attacks, and defenses. *Technologies*, 11(3), 76.
- Mylonas, A., Kastania, A., & Gritzalis, D. (2013). Delegate the smartphone user? Security awareness in smartphone platforms. *Computers & Security*, 34, 47-66.

- Ophoff, J., & Robinson, M. (2014, August). *Exploring end-user smartphone security awareness within a South African context*. In 2014 Information Security for South Africa, South Africa.
- Park, M. J. (2016). *Mobile device security: Young people's awareness and perceptions* [Doctoral Dissertation Potchefstroom Campus of the North-West University South Africa]. Boloka, the open-access Institutional Repository. <https://repository.nwu.ac.za/handle/10394/19863>.
- Park, M. & Drevin, L. (2016). An investigation into the security behaviour of tertiary students regarding mobile device security. CONF-IRM 2016 Proceedings, 63. <https://aisel.aisnet.org/confirm2016/63>
- Parker, F., Ophoff, J., Van Belle, J. P., & Karia, R. (2015, November). *Security awareness and adoption of security controls by smartphone users*. In 2015 Second International Conference on information security and Cyber Forensics (InfoSec), Cape Town, South Africa.
- Pew Research Center (2022). Internet, smartphone and social media use, <https://www.pewresearch.org/global/2022/12/06/internet-smartphone-and-social-media-use-in-advanced-economies-2022/>, Eriřim Tarihi: 24.11.2024.
- Sansom-Daly, U. M., & Bradford, N. (2020). Grappling with the "human" problem hiding behind the technology: Telehealth during and beyond COVID-19. *Psycho-Oncology*, 29(9), 1404.
- Shah, P., & Agarwal, A. (2020). Cybersecurity behaviour of smartphone users in India: an empirical analysis. *Information & Computer Security*, 28(2), 293-318.
- Stylios, I., Kokolakis, S., Thanou, O., & Chatzis, S. (2016). *Users' attitudes on mobile devices: can users' practices protect their sensitive data?* 2016 Mediterranean Conference on Information Systems (MCIS), Cyprus, Greece.
- Symantec (2015). Internet Security Threat Report. <https://dig.watch/resource/symantec-2015-internet-security-threat-report>, Eriřim Tarihi: 20.11.2024.
- Talan, T., Aktürk, C., Korkmaz, A., & Gülseçen, S. (2015). Üniversite öğrencilerinin akıllı telefon kullanımında güvenlik farkındalığı. *Istanbul Journal of Open and Distance Education*, 1(2).
- Truong, H. T. T., Lagerspetz, E., Nurmi, P., Oliner, A. J., Tarkoma, S., Asokan, N., & Bhattacharya, S. (2014, April). The company you keep: Mobile malware infection rates and inexpensive risk indicators. In Proceedings of the 23rd international conference on World wide web, 39-50. Seoul, Republic of Korea.
- Wasserman, R. (2022). The Most Common Mobile Security Threats in 2022, <https://www.pingidentity.com/en/resources/blog/post/common-mobile-security-threats.html#Common-Mobile-Security-Threats>, Eriřim Tarihi: 25.11.2024.
- Worgotter, N. (2011). *Measurement model to assess market-driving ability in corporate entrepreneurship*. [Doctoral dissertation], University of Pretoria, Pretoria.
- Zhang, X. J., Li, Z., & Deng, H. (2017). Information security behaviours of smartphone users in China: an empirical analysis. *The Electronic Library*, 35(6), 1177-1190.



The Evolution of Digital Stories: Bibliometric Analysis

Dijital Hikayelerin Evrimi: Bibliyometrik Analiz

Aydın BULUT¹

Keywords

1. Digital stories
2. Bibliometric analysis
3. Mapping

Anahtar Kelimeler

1. Dijital hikayeler
2. Bibliyometrik analiz
3. Haritalama

Received/Başvuru Tarihi

21.01.2025

Accepted / Kabul Tarihi

25.07.2025

Abstract

Purpose: The present study has been designed to analyse the extant literature on 'digital stories' from a bibliometric perspective, with a view to creating a bibliometric map of studies investigating their use in educational environments.

Design/Methodology/Approach: In this study, a range of analytical methods were employed to analyse studies on 'digital stories'. These methods included publication co-citation analysis, author co-citation analysis and word frequency analysis. Descriptive data on the distribution of studies in the field by country, institution and time were obtained from the Web of Science (WoS) database. The analysis was performed using 'R version 12.0 software' and various libraries including 'bibliometrix', 'wordcloud' and 'ggplot2'.

Findings: A bibliometric analysis of 597 articles on 'digital stories' published in the WoS database since 2005 was conducted, and the results obtained are presented in all aspects. Between 2005 and 2025, 597 articles from 270 sources on 'digital stories' were published, with an average of 29.85 articles published per year. The average number of citations per document for these articles is 15.91, and the total number of references is 19,958. The number of Keywords Plus for these articles is 556, and the number of Author's Keywords is 1,633. The number of authors of single-author documents is 156, and the number of authors of multi-author documents is 1,166. The number of single-authored documents is 168, while the number of multi-authored articles is 429. The average number of co-authors per article is 2.53, and the international co-authorship rate is 10.22%.

Highlights: The findings of this study demonstrate the considerable potential of digital storytelling to align with contemporary educational approaches, its interdisciplinary applicability, and its capacity to promote student-centred teaching methodologies. It was revealed that digital storytelling contributes to the acquisition of 21st-century skills, especially in terms of increasing student engagement, personalising learning, encouraging creative thinking, and developing digital literacy skills.

Öz

Çalışmanın amacı: Bu çalışma, eğitim ortamlarında kullanımlarını araştıran çalışmaların bibliyometrik bir haritasını oluşturmak amacıyla 'dijital hikayeler' üzerine mevcut literatürü bibliyometrik bir bakış açısıyla analiz etmek için tasarlanmıştır.

Materyal ve Yöntem: Bu çalışmada, 'dijital hikayeler' üzerine yapılan çalışmaları analiz etmek için bir dizi analitik yöntem kullanılmıştır. Bu yöntemler arasında yayın ortak atfı analizi, yazar ortak atfı analizi ve kelime sıklığı analizi yer almaktadır. Alandaki çalışmaların ülke, kurum ve zamana göre dağılımına ilişkin tanımlayıcı veriler Web of Science (WoS) veri tabanından elde edilmiştir. Analiz, 'R version 12.0 yazılımı' ve 'bibliometrix', 'wordcloud' ve 'ggplot2' gibi çeşitli kütüphaneler kullanılarak gerçekleştirilmiştir.

Bulgular: WoS veri tabanında 2005 yılından bu yana yayınlanan 'dijital hikayeler' konulu 597 makalenin bibliyometrik analizi yapılmış ve elde edilen sonuçlar tüm yönleriyle sunulmuştur. 2005 ve 2025 yılları arasında 'dijital hikâyeler' üzerine 270 kaynaktan 597 makale yayımlanmıştır ve yılda ortalama 29,85 makale yayımlanmıştır. Bu makaleler için belge başına ortalama atfı sayısı 15,91 ve toplam referans sayısı 19.958'dir. Bu makaleler için Keywords Plus sayısı 556, Yazarın Anahtar Sözcükleri sayısı ise 1.633'tür. Tek yazarlı belgelerin yazar sayısı 156, çok yazarlı belgelerin yazar sayısı ise 1.166'dır. Tek yazarlı doküman sayısı 168, çok yazarlı makale sayısı ise 429'dur. Makale başına ortalama ortak yazar sayısı 2,53 ve uluslararası ortak yazar oranı %10,22'dir.

Önemli Vurgular: Bu çalışmanın bulguları, dijital hikâye anlatımının çağdaş eğitim yaklaşımlarıyla uyum sağlama potansiyelini, disiplinler arası uygulanabilirliğini ve öğrenci merkezli öğretim metodolojilerini teşvik etme kapasitesini ortaya koymaktadır. Dijital hikâye anlatımının özellikle öğrenci katılımını artırma, öğrenmeyi kişiselleştirme, yaratıcı düşünmeyi teşvik etme ve dijital okuryazarlık becerilerini geliştirme açısından 21. yüzyıl becerilerinin kazanılmasına katkıda bulunduğu ortaya çıkmıştır.

¹ Kastamonu University, Kastamonu, Türkiye; <https://orcid.org/0000-0003-3139-4367>

INTRODUCTION

Digital technologies have become pervasive in almost every aspect of social life in recent years, driven by the acceleration of global digitalisation. Education has been particularly impacted by this transformation, with traditional teaching methods being replaced by increasingly digital content, tools and applications. This shift has led to a transformation in teaching environments, making learning processes more interactive, flexible and individualised. The integration of digital tools into learning-teaching processes has become a common practice. Digital stories are a salient example of such innovative and effective forms of expression that are witnessing increasing adoption in educational settings. A digital story is defined as the narration of personal or fictional content through technological means, typically involving the integration of diverse digital media elements such as text, sound, music, photography, video and animation. This form of narration enables individuals to articulate their experiences, reflections, or knowledge-based content, enriching it with multimedia elements. Digital storytelling fosters engagement, both cognitive and affective, among learners, thereby enhancing their learning experience.

The utilisation of digital stories in educational settings has been demonstrated to not only enhance the diversification of content presentation but also to contribute to the cultivation of 21st-century competencies, including creative thinking, problem-solving, collaboration, and digital literacy (Smith, 2020). This pedagogical approach, which has been found to be efficacious across various disciplines, such as language education, history, science, and social studies, can be seamlessly integrated with the overarching objectives of curricula. The evolution of digital stories from past to present, and their functional transformation in education, serve as a valuable reference source for academic researchers, practising teachers, and decision makers who influence educational policies. A deeper understanding of the capabilities offered by these tools in the educational context is essential for enhancing the quality of teaching practices and facilitating the adoption of innovative learning approaches, which are essential in the digital age.

Digital Stories

Digital stories, which have seen increased usage in the field of education in recent years, are classified into three main categories: personal narratives, historical documentaries, and content that aims to inform and educate audiences about various topics and concepts (Robin, 2016). Researchers emphasise that the most basic components of an effective digital story are a strong script and a well-structured narrative (Robin & McNeil, 2012). In this regard, it is asserted that creators of digital stories should prioritise the development of the narrative (Ohler, 2006). The digital storytelling process necessitates not only the effective utilisation of technological tools, but also the aesthetically and pedagogically effective construction of the narrative structure. In this process, individuals aim to create interaction at both emotional and cognitive levels by integrating their experiences or the information they want to convey with multimedia elements (text, visual, audio, music and video) (Sadik, 2008). In this respect, digital stories contribute to the development of 21st century skills such as creativity, critical thinking, communication and collaboration (Barrett, 2006). Furthermore, digital stories offer personalised and meaningful learning experiences by encouraging students' active participation in the learning process (Robin, 2008). In particular, the use of the narrator's voice facilitates an emotional connection between the learner and the content and increases learning motivation (Robin, 2008). Therefore, digital storytelling is considered not only as a technical application but also as a pedagogical strategy.

In the context of education, concrete applications of digital stories manifest in various forms across different disciplines and educational levels. Notably in language education, history, science and social studies courses, students engage in the creation of digital stories, both individually and collaboratively, thereby facilitating active participation in learning processes (Reinders, 2010). For instance, in a foreign language course, students' digital narration of short stories from their own lives in the target language enhances their linguistic competence and fosters cultural awareness.

In history lessons, students have the opportunity to create digital documentary stories accompanied by historical documents, photographs and maps by researching events that happened in the past (Gregori-Signes, 2008). This process supports the development of historical thinking skills. In fields such as science and mathematics, students have the opportunity to visualise and explain their learning outcomes by explaining a scientific process, an experiment result or a concept through digital stories. Furthermore, educators employ digital stories as course materials, utilising these tools for purposes such as conceptualising abstract concepts, creating impactful introductions and fostering emotional engagement among students, thereby enhancing the efficacy of the teaching process and contributing to the establishment of a student-centred learning environment.

The utilisation of digital storytelling in educational settings is not confined to content production; it also emerges as an alternative tool in assessment processes. Digital stories, which exceed conventional assessment and evaluation methods, enable the assessment of students' knowledge levels, skills such as critical thinking, problem solving, creative expression and digital literacy in a holistic manner (Jakes & Brennan, 2005). The process of students creating their own digital stories provides rich data for both product- and process-oriented assessment, thus providing teachers with a more in-depth perspective on the learning process (Jakes & Brennan, 2005).

However, in order to effectively integrate digital storytelling into the teaching process, teachers need to have sufficient knowledge and skills in this field. For this reason, it is of great importance to provide practical training on digital story design, pedagogical use of digital tools and creative expression techniques in teacher education programmes (Yang & Wu, 2012). Teachers' acquisition of these skills not only enriches classroom practices but also plays an important role in increasing students' learning motivation and academic achievement. Digital storytelling has been identified as a transformative pedagogical tool, capable of

enhancing teaching and learning processes (Yang & Wu, 2012). By encouraging students to create meaningful, personal and creative products, this method fosters a more interactive and participatory learning environment. The active involvement of students in the digital story creation process is a crucial component of the learning experience, as evidenced by the digital stories created by students. These stories underscore the importance of participation in the learning process, highlighting it as both encouraging and essential. In this process, students have the opportunity to construct, make sense of and reflect on their learning of the content units through the digital stories they prepare. Furthermore, digital storytelling makes the learning process more systematic and interdisciplinary by requiring students to follow the steps of project development in a planned manner within a specific content context.

The integration of digital stories in programming and IT-based applications has been demonstrated to contribute to the development of students' complex problem-solving and cognitive skills by enabling the use of a large number of commands and functions together (Ohler, 2013; Yang & Wu, 2012). In this context, the process of developing digital stories has been shown to require not only technical knowledge, but also a pedagogical approach that supports students' creative thinking skills (Yang & Wu, 2012). Indeed, a substantial body of research has demonstrated the positive impact of digital story creation on creative thinking (see Ohler, 2013; Yang & Wu, 2012). In the process of digital story creation, visual design elements play a pivotal role in terms of the effectiveness of the learning experience. The conscious and purposeful use of elements such as colour, composition, typography and sound serves to enhance the aesthetic value of the story and enables the message to be conveyed more effectively. Consequently, it is imperative for students to be attentive not only to the content but also to the manner in which the story is presented, thereby fostering the development of contemporary competencies such as digital literacy and media literacy (Hobbs, 2011). In addition, the suitability of the tools used in the digital storytelling process for pedagogical purposes is of great importance. Digital platforms (e.g. Storyboard That, WeVideo, Powtoon, Adobe Express, etc.) should be selected by considering the age level, technological competences and learning objectives of the students, both to increase the functionality of the process and to prevent technical difficulties. In order to facilitate the effective integration of these tools into pedagogical practice, it is recommended that in-service training programmes should include the use of digital tools and story design. Conversely, the integration of digital stories into curricula enables the design of student-centred and creative learning environments. The alignment of learning outcomes in the curricula with digital storytelling facilitates both students' in-depth learning and their emotional connection to the learning process. This approach has been shown to yield highly effective results when integrated with project-based learning models, especially in interdisciplinary projects.

Current studies

In their 2024 study, Manganello and Baldacci examined the efficacy of digital storytelling in fostering inclusivity and enhancing communicative competence, encompassing both linguistic and narrative abilities, within a multicultural primary school classroom in Genoa, Italy. In their experimental study, Ulusoy & Ulusoy (2024) investigated the effects of retelling, reading response and combined retelling and reading response activities on second grade students' reading attitudes and story comprehension levels after watching digital stories. Metin et al., (2024) sought to examine the impact of a digital story design programme, also referred to as the Design-Based Digital Story Programme (DBDS), on the coding and IT skills of 5-year-old children. Similarly, especially in the past (Ramírez Verdugo & Alonso Belmonte, 2007; Valkanova & Watts, 2007) as well as today (Arevalo et al., 2024; Jiang, 2024) there are many studies on digital stories. A bibliometric analysis of digital stories, which are frequently employed in the learning process, has the potential to make a number of contributions to the field.

Focus of this study

A substantial corpus of academic research has been dedicated to the study of digital storytelling, encompassing a broad spectrum ranging from early childhood education to higher education. This research spans a timeframe from the past to the present. A thorough review of these studies has the potential to provide significant academic insights for researchers and practitioners, particularly in the current era of artificial intelligence. Digital storytelling has been identified as a powerful tool with the potential to bring innovative dimensions to the field of education. Indeed, there has been a noticeable increase in the number of studies on the use of artificial intelligence in education in recent years (see Cui, 2022; Hsiao & Chang, 2023; Xu, 2025). A review of studies on digital stories reveals a preponderance of research evaluating articles, books, and papers published at both national and international levels. This situation clearly reveals the need for current and systematic bibliometric studies in the field of digital storytelling. In this context, the present study aims to analyse the extant literature focusing on the use of digital storytelling in an educational context using bibliometric methods, with a view to revealing the structure, trends, and developmental orientations of research in this field. The ultimate objective of this analysis is to map the conceptual and temporal development of academic knowledge on digital storytelling and to establish a comprehensive knowledge ecosystem for the field. In this framework, the following research questions were investigated:

1. Who are the most influential authors on 'digital stories'?
2. Which universities and countries are the most influential in 'digital stories'?
3. What is the status of citations related to 'digital stories' in education?
4. What are the keywords and trending topics related to 'digital stories'?
5. How do clusters emerge according to author matching in journal research on 'digital stories'?

The academic originality of this study lies in its systematic examination of the extant literature on digital storytelling using a bibliometric approach. This has enabled the revelation of the historical development, conceptual structures, research trends, and prominent clusters of work in the field. Despite the long-standing utilisation of digital storytelling as an educational methodology, there remains a paucity of comprehensive and systematic analysis in the extant literature concerning the novel forms of this method in the era of artificial intelligence. The present study provides researchers with guiding thematic foci for future work by presenting citation analyses from both national and international publications, networks of co-occurring key concepts, and visual data on publication densities. Moreover, the study employs bibliometric analysis methodologies to identify influential authors, journals, countries, and collaboration networks, thereby rendering collaboration models and academic centres in the field visible. In this respect, the study not only analyses the past but also provides a strategic literature map that identifies future research opportunities in the field of digital storytelling. In this context, it is expected to contribute to data-driven decision-making processes for policymakers, educational designers, and academics regarding the integrated use of digital stories in educational technologies.

METHOD

The present study was conceived with the objective of undertaking a systematic review of the extant academic literature on digital stories from a thematic perspective. The research process was structured in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher et al., 2009) and consisted of four main stages: (1) determining inclusion and exclusion criteria, (2) literature review and study selection, (3) data extraction, and (4) bibliometric analysis.

Inclusion and exclusion criteria

In accordance with the objective, a set of scope determination criteria incorporating content and methodological criteria has been formulated. Within this framework, the present study encompasses peer-reviewed journal articles published between 2005 and 2025 (March) that focus on digital stories. In order to enhance the scientific validity and reliability of the study, the selected articles were identified from publications indexed in the Web of Science (WoS) database (Falagas et al., 2008; Mongeon & Paul-Hus, 2016). The incorporation of prominent, internationally renowned academic journals within the Web of Science database has enabled a meticulous and contemporary literature review on the subject (Zupic & Čater, 2015). The present study encompasses articles for which the full text is available. The scope of this study encompasses document types that are not included in the analysis. These include book chapters, conference proceedings, publications without full text, and unpublished documents. This exclusion was applied with the objective of ensuring data integrity and enhancing the comparability of the analysis (Moher et al., 2009).

Literature search and study identification

A literature review was conducted using the Web of Science database. The following keywords were used: TS= ("digital stories" OR "digital story" OR "digital story telling" OR "digital story-telling" OR "digital storytelling" OR "educational digital storytelling"). In the first stage, the obtained records were screened preliminarily based on their titles, abstracts and keywords. The full texts of the appropriate studies were then evaluated. During this process, bibliographic data management was organised using Zotero.

Data screen

A systematic extraction process was applied to obtain bibliographic data such as publication year, author(s), country, institution, number of citations, journal of publication, keywords, and abstracts from the selected studies. The obtained data were transferred to the Bibliometrix (R-Biblioshiny) software for bibliometric analysis. The dataset utilised in the analysis was standardised in plain text format as required by the software (Aria & Cuccurullo, 2017). The data screening and pre-processing process was structured as a systematic narrowing process consisting of several sequential steps to ensure that the literature most relevant to the scope of the study was selected. The objective of these steps was to create a high-quality sample for analysis while preserving the methodological and content integrity of the literature (see Figure 1).

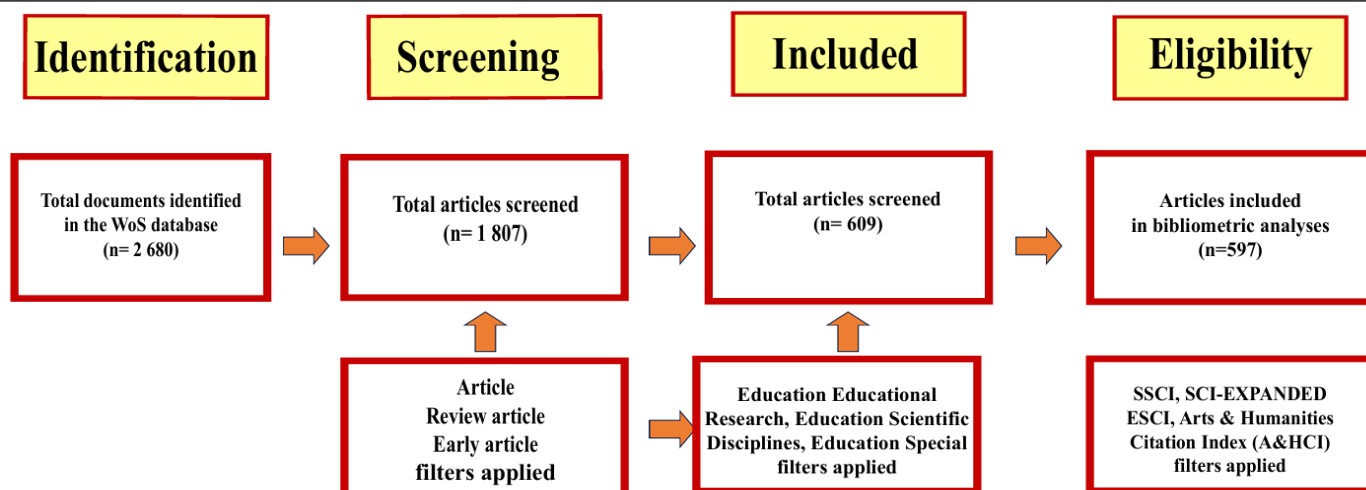


Figure 1. PRISMA flow chart

Data Analysis

During the analysis process, the distribution of publications by year, the most prolific authors and institutions, geographical distribution, frequently used keywords, citation counts, networks of relationships between sources, and academic collaboration models were examined in detail. Conceptual structures were identified using methods such as "synchronisation", "co-citation", and "source matching", and concept maps and collaboration networks were created accordingly. The software tool utilised in the study was employed to evaluate strategic theme maps, theme densities, and time-dependent development trends. This methodological approach facilitates a more comprehensive understanding of the impact of artificial intelligence technologies on STEM education and sheds light on the development process of academic production in this field. The descriptive findings related to the examined publications are presented in Table 1.

Table 1.Descriptive data of Obtained Studies

Description	Results
Timespan	2005:2025 (March)
Sources	270
Documents	597
Annual average number of publications	29.85
Average citations per doc	15.91
Total references	19 958
Keywords Plus (ID)	556
Author's Keywords (DE)	1 633
Authors	1 334
Co-Authors per Doc	2.53
International co-authorships (%)	10.22

FINDINGS AND INTERPRETATIONS

The annual scientific production related to the study is illustrated in Figure 2. A detailed analysis of Figure 2 reveals an average of 12.54 articles on 'digital stories' from 2005 to 2015, including 2015. From 2016 to 2025, this average increases to 45.9. A notable increase in the number of publications was observed in 2024, with 71 articles published in that year alone. The number of citations received by these articles according to the year of publication is illustrated in Figure 3.

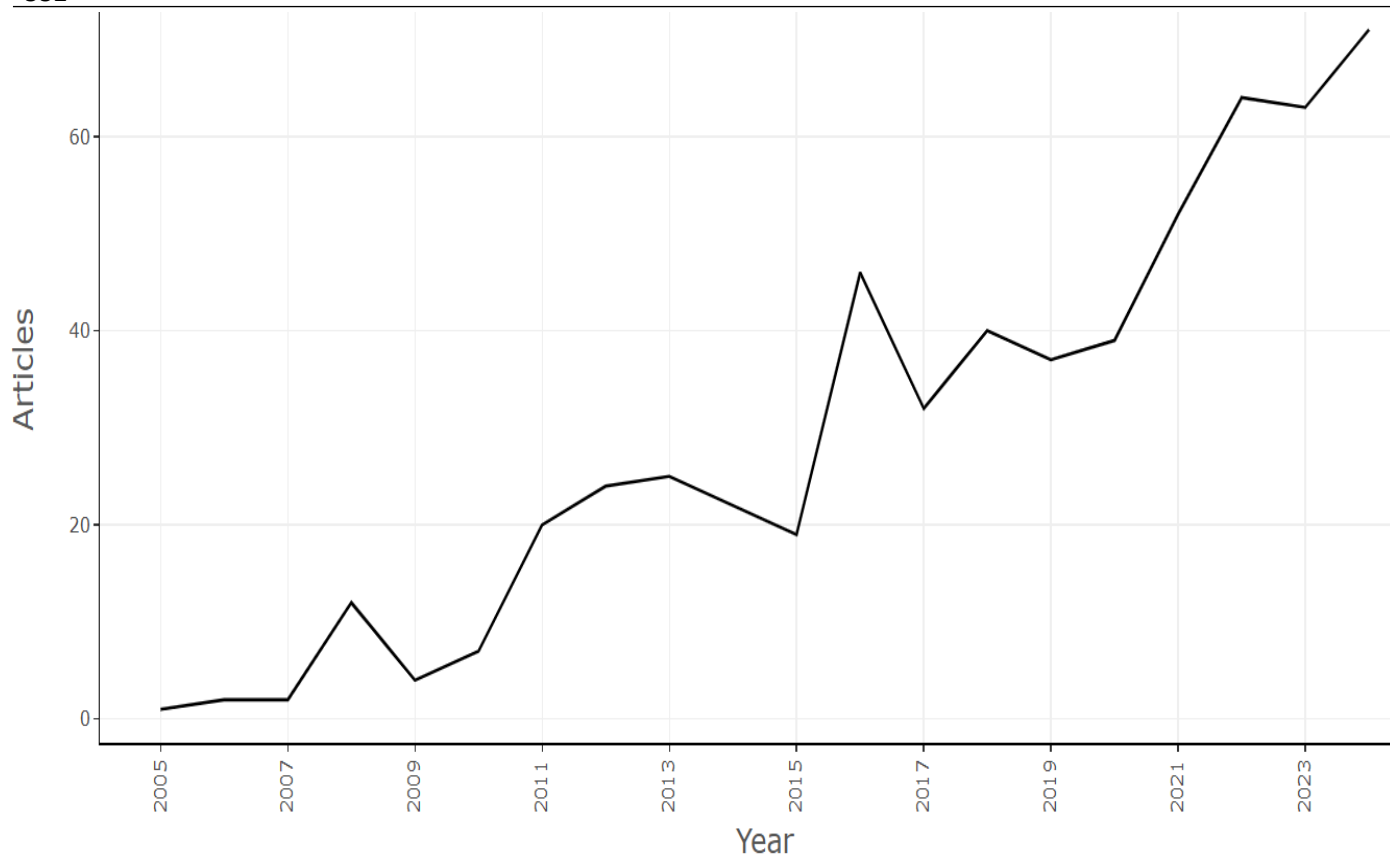


Figure 2. Annual scientific production

As illustrated in Figure 3, the figure for citations of 597 articles published on 'digital stories' from 2005 to 2025 demonstrates a significant increase in the average number of citations per document in 2006. However, in the subsequent years, a decline was observed. Figure 4 presents the three-field plot (author-keyword-affiliation).

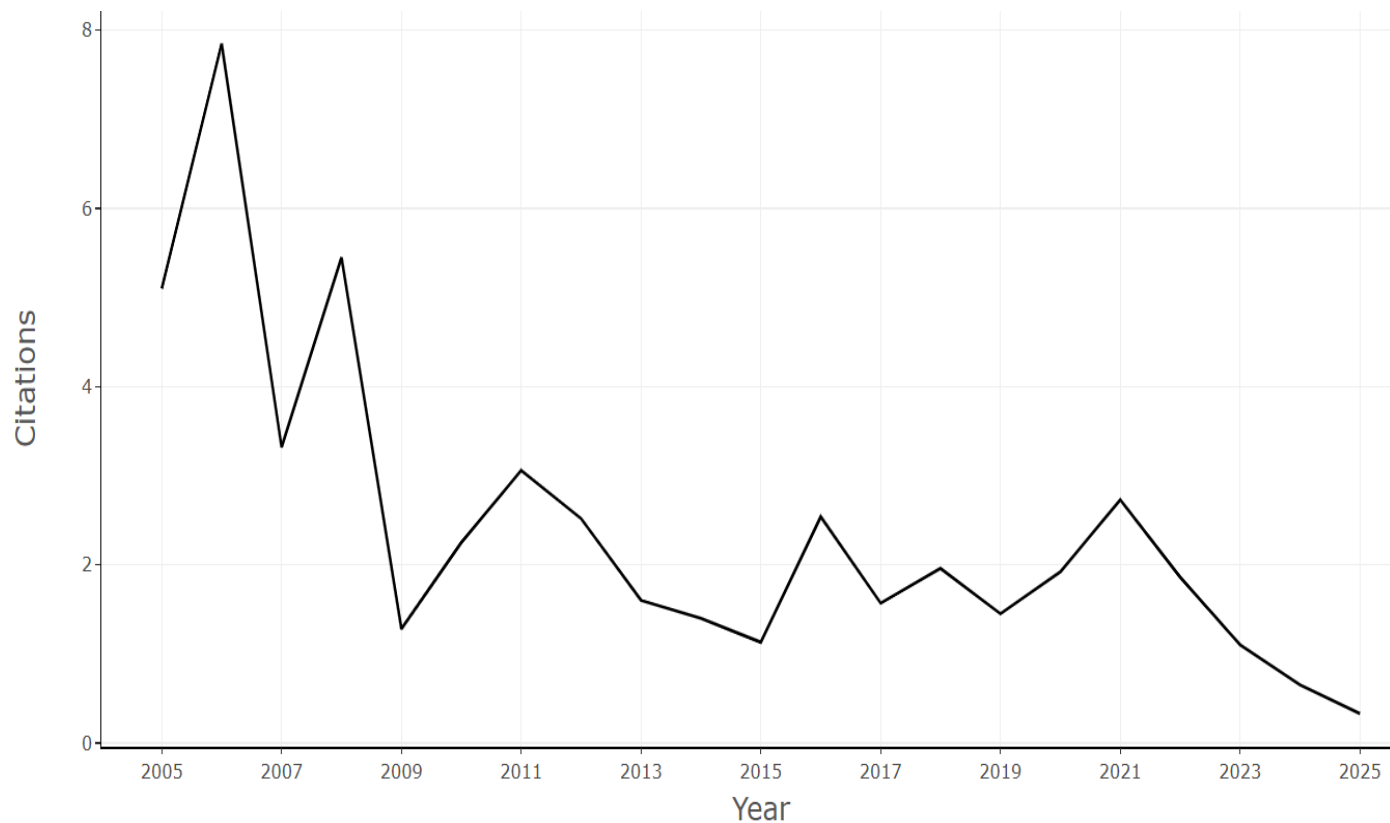


Figure 3. Annual citations production

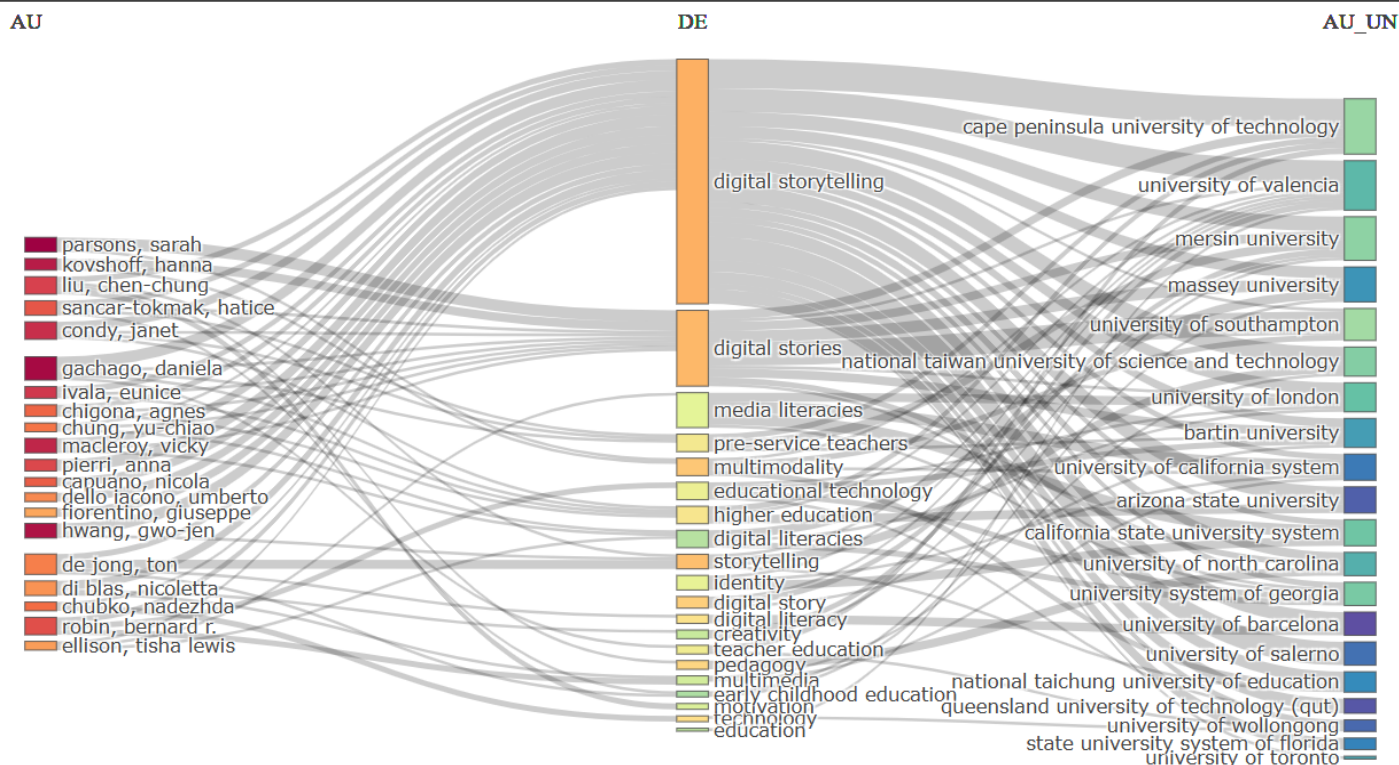


Figure 4. Three-field plot (keyword-author-affiliation)

A total of 270 sources pertaining to 'digital stories' were identified in the Web of Science database. The 10 sources with the highest number of publications in the journal are illustrated in Figure 5. Upon analysis of Figure 5, it is evident that Education and Information Technologies ranks first with 17 studies. Digital Education Review, Education Sciences, Educational Technology & Society ranked second with 11 studies, while Computers & Education ranked third with 10 studies.

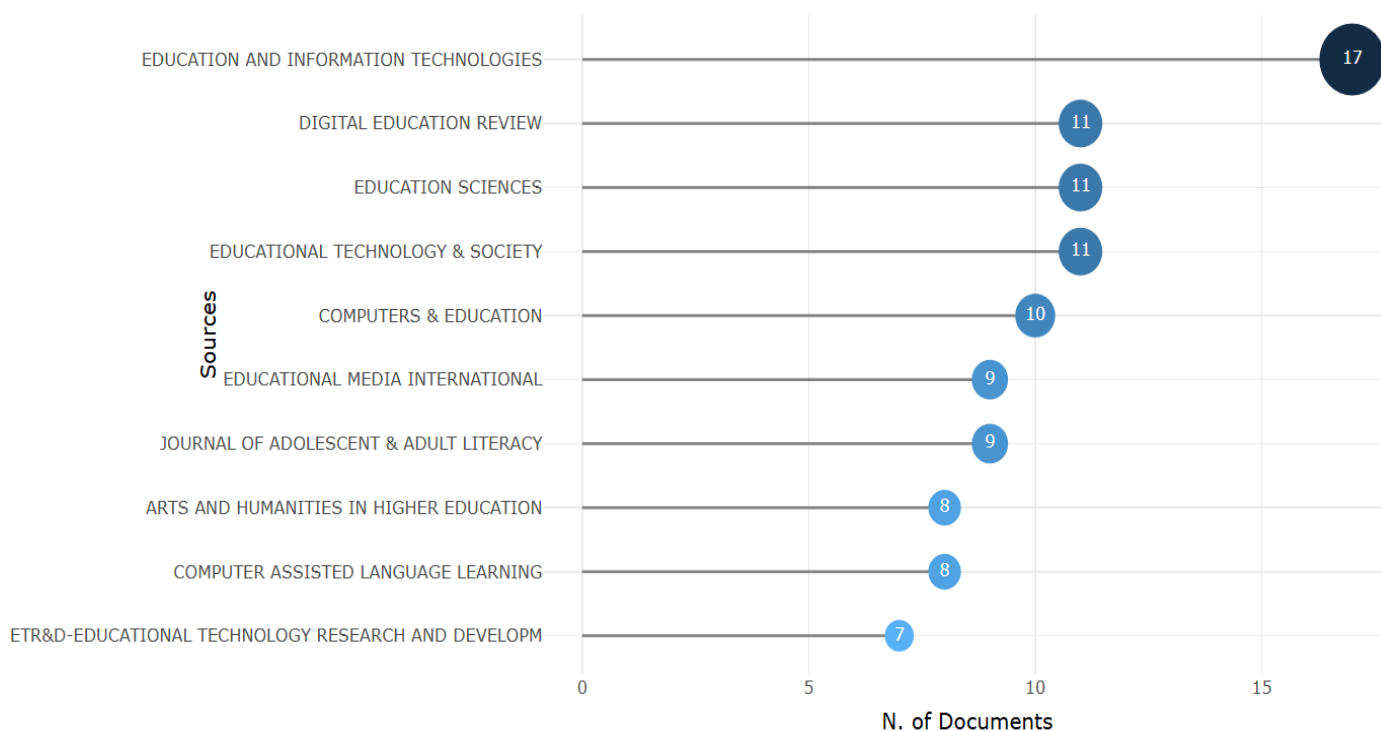


Figure 5. Most Relevant Sources

A total of 1,334 researchers who have published on the subject of 'digital stories' are listed in the Web of Science database. The 10 authors with the highest number of publications in the journal are illustrated in Figure 6. When Figure 6 is subjected to analysis, Parsons, Sarah is ranked first with eight studies. Gachago, Daniela; Hwang, Gwo-Jen; Kovshoff, Hanna are ranked second with six studies, while Macleroy, Vicky is ranked third with five studies.

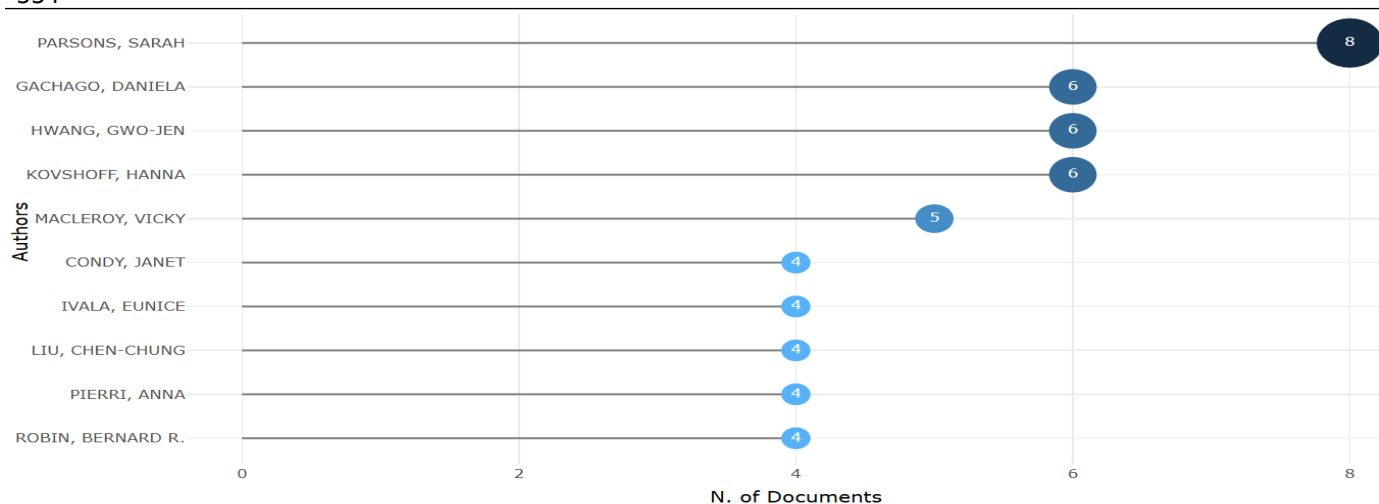


Figure 6. Most relevant authors

The most globally cited articles concerning 'digital stories' are enumerated in Table 2. The first article is 'Digital Storytelling: A Powerful Technology Tool for the 21st Century Classroom.' by Bernard R. Robin in 2008 with 524 citations. The second most frequently cited article is 'Digital storytelling: a meaningful technology-integrated approach for engaged student learning' by Sadik, A. in 2008, with 332 citations. The third most frequently cited article is 'Digital storytelling for enhancing student academic achievement, critical thinking, and learning motivation: A year-long experimental study' by Yang, Y. T. C., & Wu, W. C. I. in 2012 with 328 citations.

Table 2. Most Global Cited Documents

Document	DOI	Total Citations	T C Per Year
Robin Br, 2008, Theor Pract	10.1080/00405840802153916	524	29.11
Sadik A, 2008, Etr&D-Educ Tech Res	10.1007/s11423-008-9091-8	332	18.44
Yang Ytc, 2012, Comput Educ	10.1016/j.compedu.2011.12.012	328	23.43
Huh Ga, 2006, Res Teach Engl	https://doi.org/10.58680/rte20065995	226	11.30
Hafner Ca, 2011, Lang Learn Technol	http://lt.msu.edu/issues/october2011/hafnermiller.pdf	201	13.40
Hung Cm, 2012, Educ Technol Soc	https://www.jstor.org/stable/10.2307/jeductechsoci.15.4.368	168	12.00
Haigh C, 2011, Nurs Educ Today	10.1016/j.nedt.2010.08.001	145	9.67
Robin Br, 2016, Digit Educ Rev	NA	144	14.40
Benmayor R, 2008, Arts Hum High Educ	10.1177/1474022208088648	142	7.89
Agbo Fj, 2021, Smart Learn Environ	10.1186/s40561-020-00145-4	134	26.80
Barkhuizen G, 2016, Tesol Quart	10.1002/tesq.311	129	12.90
Phan T, 2016, Comput Educ	10.1016/j.compedu.2015.11.015	123	12.30
Jernigan Vbb, 2012, Health Educ Res	10.1093/her/cyr089	113	8.07
Ohler J, 2005, Educ Leadership	NA	107	5.10
Verdugo Dr, 2007, Lang Learn Technol	NA	103	5.42
Yang Ytc, 2022, Comput Assist Lang L	10.1080/09588221.2020.1750431	100	25.00
Xu Y, 2011, Educ Technol Soc	NA	96	6.40
Nelson Me, 2006, Lang Learn Technol	NA	88	4.40
Falloon G, 2010, Brit J Educ Technol	10.1111/j.1467-8535.2009.00991.x	86	5.38
Kim S, 2014, Lang Learn Technol	NA	75	6.25
Hava K, 2021, Comput Assist Lang L	10.1080/09588221.2019.1650071	72	14.40
Niemi H, 2016, Technol Pedagog Educ	10.1080/1475939X.2015.1074610	72	7.20
Sarica Hc, 2016, Comput Educ	10.1016/j.compedu.2015.11.016	72	7.20
Castañeda Me, 2013, Calico J	10.11139/cj.30.1.44-62	70	5.38
Christiansen A, 2011, Nurs Educ Today	10.1016/j.nedt.2010.10.006	68	4.53

The word cloud obtained from published articles on the topic of 'digital stories' is presented in Figure 7. This word cloud reveals the main themes that digital storytelling studies focus on. The most frequently occurring concepts include technology, education, literacy, language, and learning motivation. This finding indicates that digital storytelling is characterised by a structured framework encompassing educational, technological and linguistic components. Furthermore, the concepts of 'students', 'stories', 'pedagogy' and 'engagement' indicate an emphasis on student-centred and pedagogical approaches. The visual depiction is indicative of the conceptual density and prevailing research trends within the field, thereby supporting the objective of mapping the structural landscape of the literature within the scope of bibliometric analysis.



Figure 7. WordCloud

Figure 8 provides a visual representation of the trending topics of the articles published on 'digital stories' by keywords over the years. The visualisation presented here depicts the distribution and intensity of concepts related to digital storytelling over time. In particular, concepts such as 'technology', 'education', 'students', 'learning motivation' and 'science' have assumed particular significance in the post-2020 period. This situation demonstrates that digital storytelling has rapidly evolved in the context of technology-supported education in recent times, shifting towards student-centred applications. Furthermore, it is acknowledged that concepts such as 'framework,' 'design,' and 'experience' were addressed to a greater extent in previous years. However, these concepts have gradually been superseded by more practical and output-oriented approaches. The visual reflects the temporal development of the field, thereby contributing to the study's aim of 'temporal development'.

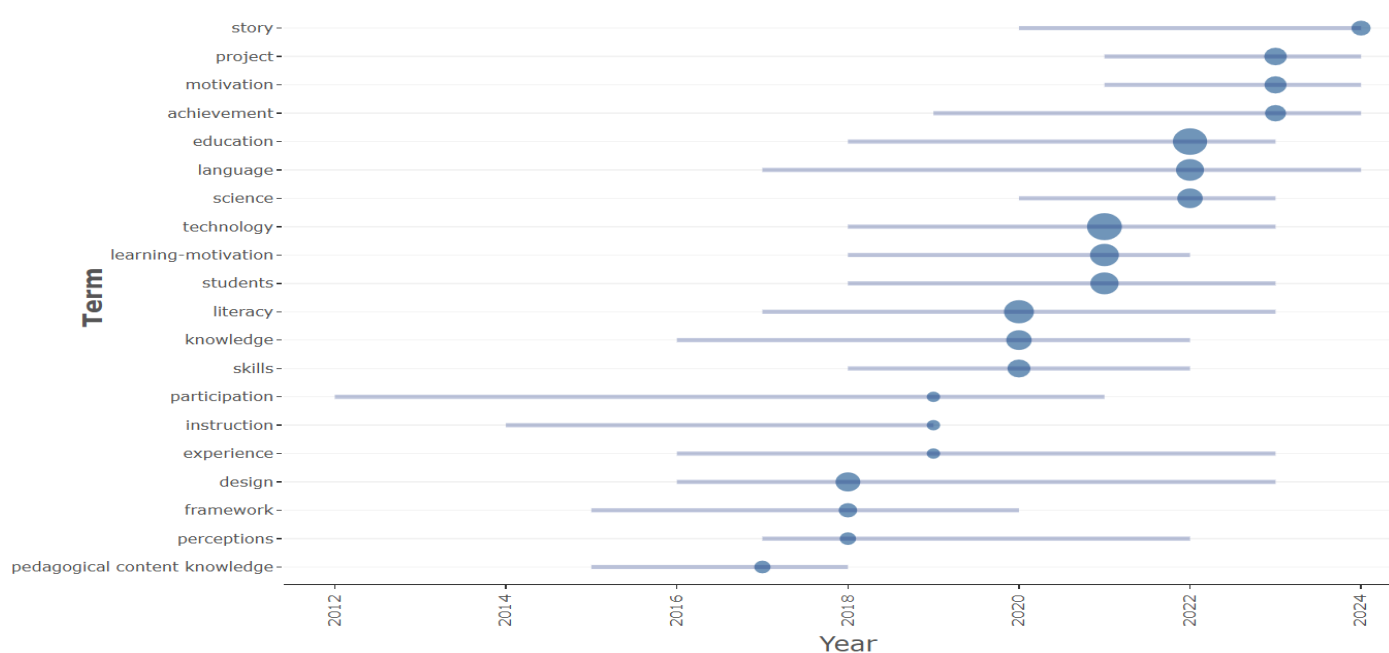


Figure 8. Trend topics (keywords)

The present study has analysed the clustering of articles published on 'digital stories' according to documents over the years (see Figure 9). This thematic map reveals the impact and centrality levels of concepts that stand out in the digital storytelling literature. Concepts such as 'education', 'technology', and 'tool' have both high centrality and impact, forming the structural core of the field. The themes of "learning-motivation," "stories," and "technology," despite their high centrality, elicit relatively lower impact levels, indicating that these themes are frequently employed in the field but nevertheless possess residual potential for in-depth analysis. Conversely, concepts such as 'literacy', 'English', and 'learners' exhibit high levels of impact but are more peripheral in terms of centrality. This finding suggests that these themes make significant contributions in specific contexts but do not occupy a central position in the overall structure. The low levels of both impact and centrality of concepts such as 'pedagogy,' 'multiliteracies,' and 'academic literacies' indicate a need for further research in these areas. This visual systematically maps the conceptual structure of the field of digital storytelling, directly contributing to the analytical objectives of the study.

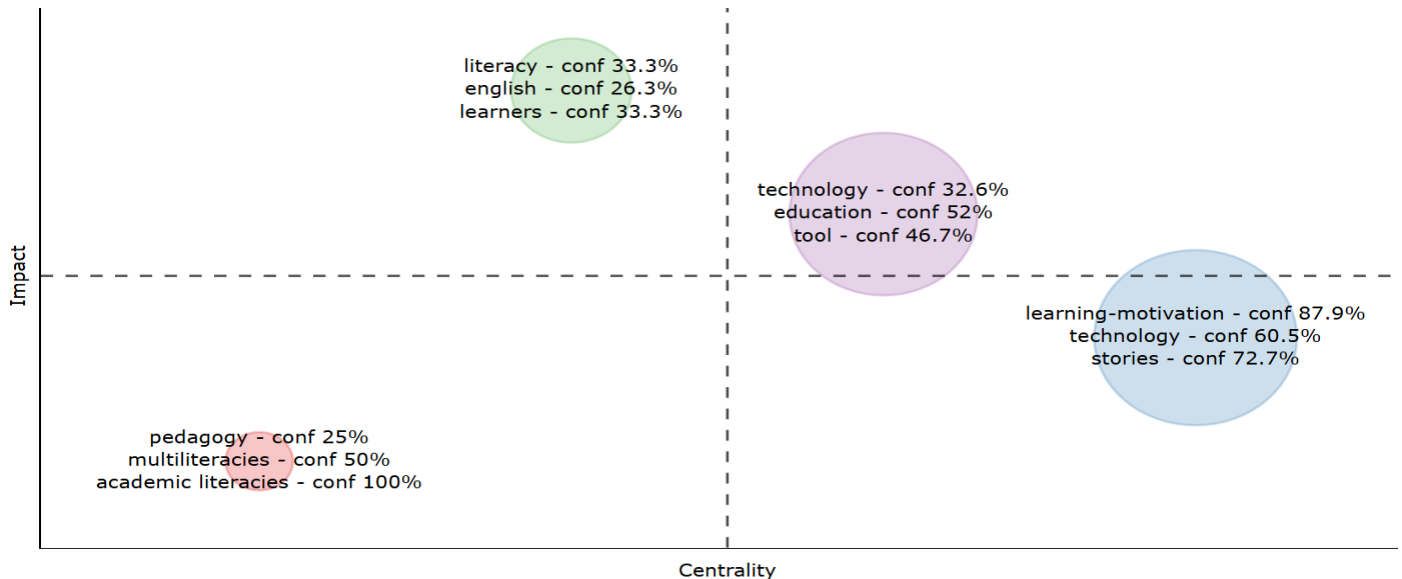


Figure 9. Clustering according to documentation

The co-occurrence network formed by the articles published on 'digital stories' according to keywords over the years was analysed and presented in Figure 10. The following keyword co-occurrence network is intended to visualise the relationships between fundamental concepts in the field of digital storytelling. The concept of 'technology' is particularly salient, exhibiting robust interconnections with concepts such as 'students,' 'science,' 'design,' and 'education.' This finding suggests a strong correlation between digital storytelling and technology-centred educational applications. The clusters of 'literacy,' 'language,' 'English,' and 'stories' on the left side of the network represent language and literacy-focused themes in the field, while concepts such as "pedagogy" and 'multiliteracies' in the lower left corner are more peripheral and have less central relationships. The overarching structure of the network indicates that digital storytelling research is predominantly focused on technology-based education, student experience, language learning, and literacy development. Consequently, this contributes substantially to the conceptual mapping objective of this study.

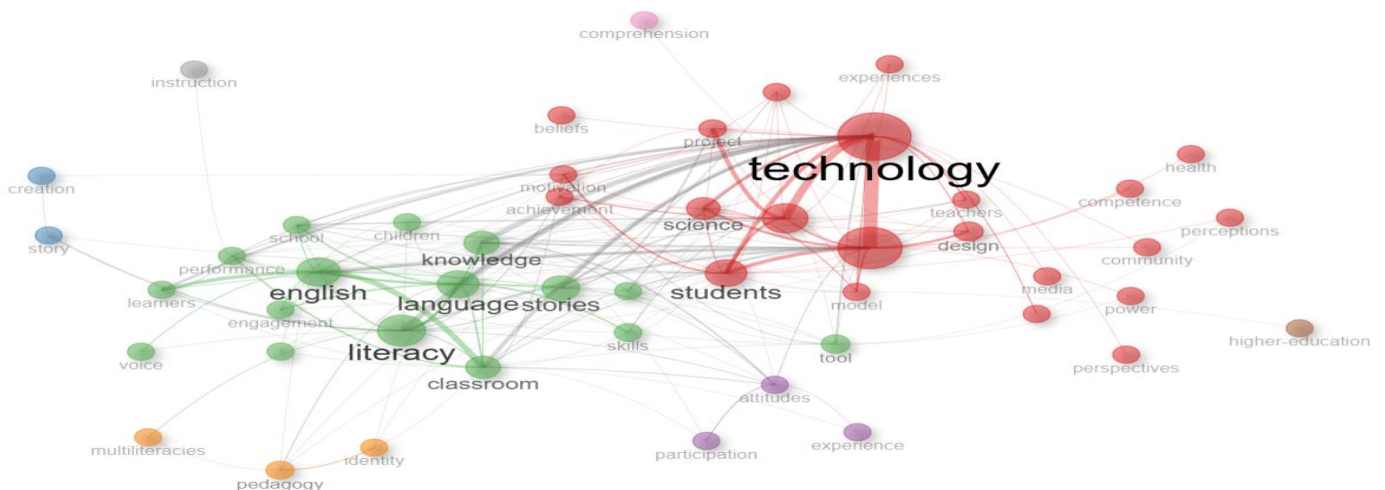


Figure 10. Co-occurrence network by keywords

The thematic evolution of articles published on 'digital stories' according to keywords over time was analysed and presented in Figure 11. The thematic evolution diagram illustrates the changes and transformations in key concepts in digital storytelling between 2005–2015 and 2016–2025. The concepts that were most salient in the first period include 'education', 'English', 'technology', 'instruction' and 'pedagogy'; the majority of these concepts are also evident in the second period, thereby demonstrating the continuity of the field. In particular, the concept of 'technology' has become more central in the 2016–2025 period while maintaining its connection to different themes from the previous period. The concepts of 'instruction' and "pedagogy" also demonstrate continuity; however, this period sees the addition of more specific and practical themes such as 'model,' 'pedagogical content knowledge,' 'diversity,' and 'children' to the literature. This transition signifies a shift in the focus of digital storytelling research from general themes to more specialised, pedagogical, and inclusive topics. The visual representation provides a clear illustration of the temporal transformation and thematic orientations of the literature, thereby directly contributing to the objective of this study.

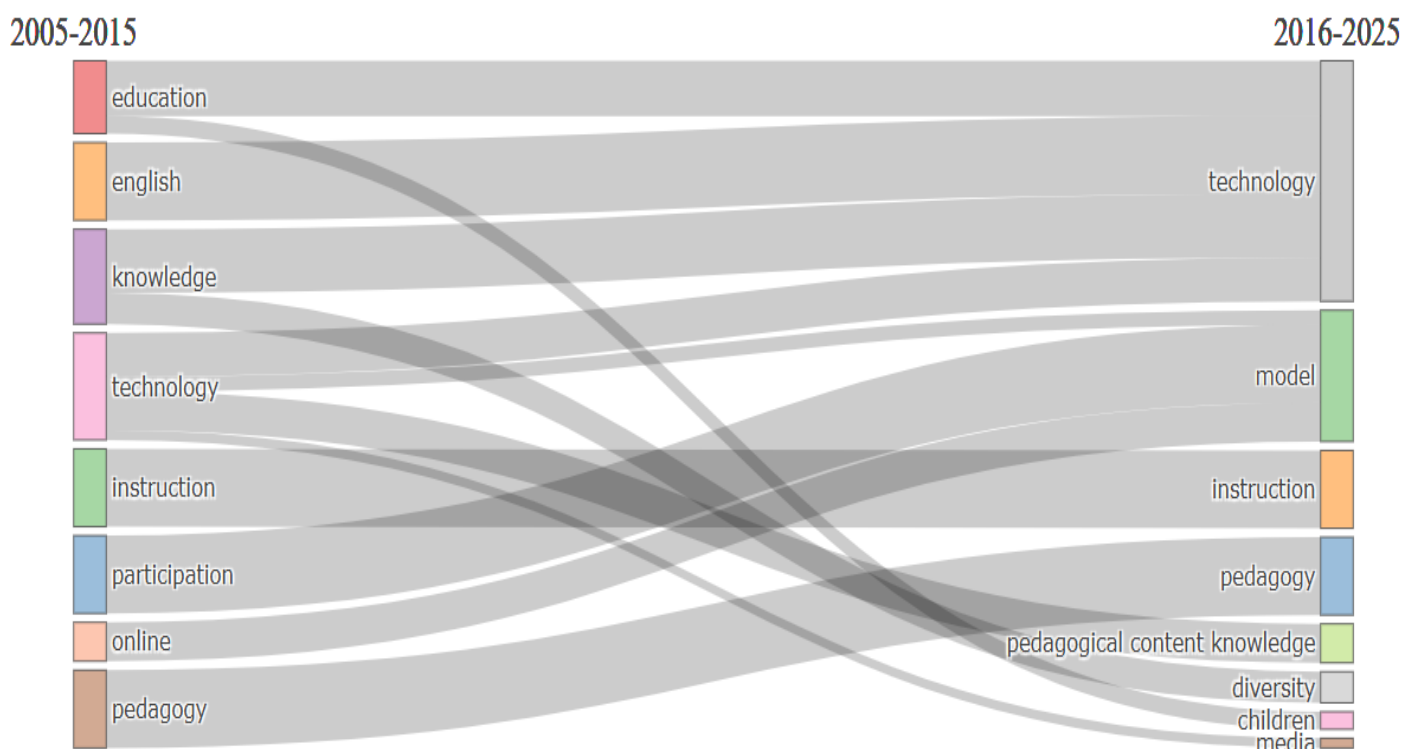


Figure 11. Thematic evolution by keywords

The collaboration networks of the organisations formed by the published articles on 'digital stories' were examined and presented in Figure 12. The visualisation depicts the corporate collaboration networks in the domain of digital storytelling. One of the pre-eminent centres on the map is the University of London, which has established strong links with Goldsmiths University London and the University of Southampton in particular. This finding indicates that institutions within the United Kingdom are playing an active role in advancing this field through collaborative initiatives and joint authorship. A similar phenomenon is evident in the extensive network of collaboration that exists among US-based universities, including prominent institutions such as the California State University System, Arizona State University, and the University of California System. The University of Houston System and the University of Georgia System also demonstrate notable distinction within their respective clusters. The National Taiwan University of Science and Technology has been identified as a key centre of collaboration in Asia, having established strong collaborative relationships with numerous academic institutions in Taiwan. In addition, the presence of three Turkish universities, namely Mersin University, Necmettin Erbakan University and Bartın University, serves to emphasise Turkey's significant contributions to the field. This visualisation contributes to the study's objective of mapping the international collaboration structure by demonstrating how digital storytelling research establishes networks at the global level and which universities are at the centre of these networks.

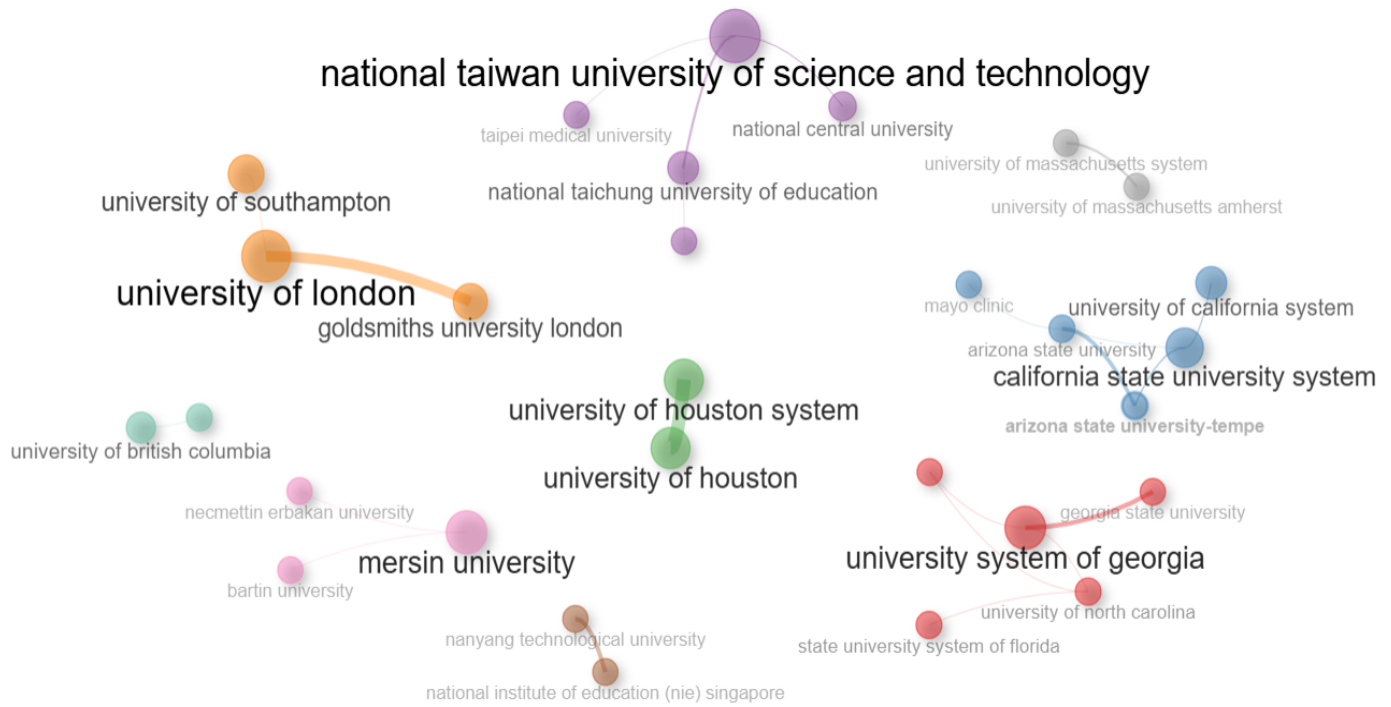


Figure 12. Institution-collaboration network

The countries' collaboration network formed by the published articles on "digital stories" was analysed and presented in Figure 13. The visualisation under consideration offers a representation of international scientific collaborations in the domain of digital storytelling. The United States (USA), located at the centre of the network, is the country with the highest number of connections and is therefore the focal point of global collaboration. The USA has cultivated robust diplomatic relations with numerous nations worldwide, notably Sweden, Germany, South Africa, Turkey and Ireland. The robust connections between the United Kingdom, Canada, and Indonesia suggest a substantial exchange of information between Western Europe and Southeast Asia. Furthermore, the establishment of regional cooperation networks between countries, including Australia, China, Korea, and Belgium, is a notable development. It is evident that smaller clusters, such as those comprising Malaysia and Pakistan, Japan and Norway, and Spain and Italy, serve as exemplars of regional cooperation. Turkey's direct connection with the United States demonstrates that our country is integrated into the global research network in this field. The visual representation provides a clear illustration of the geographical distribution of international partnerships and hub countries in the digital storytelling literature, thereby offering a substantial contribution to the study's objective of global network mapping.

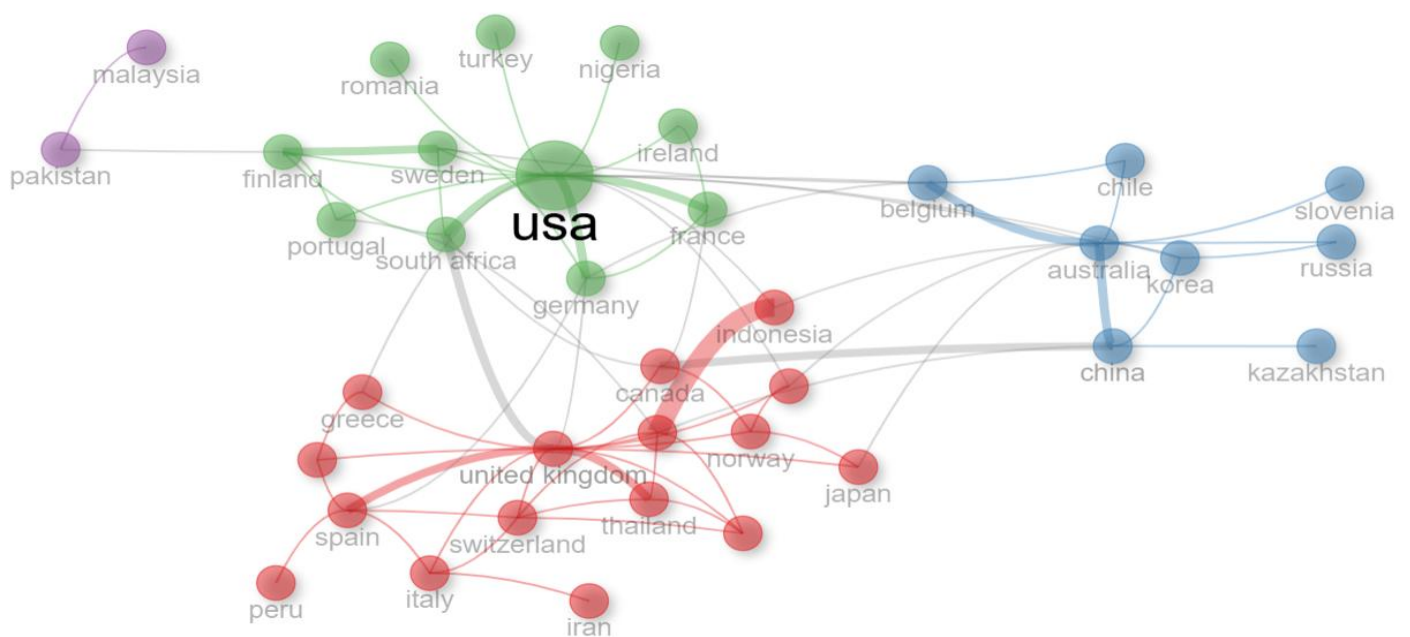


Figure 13. Countries-collaboration network

A thorough analysis was conducted on the 'Countries' collaboration world map', which was created by the countries that have published 'digital stories' over the years (see Figure 14). The world map presented here illustrates international scientific collaborations in the domain of digital storytelling. The United States, indicated on the map in dark blue, has both the highest number of publications and functions as a global hub, with active collaborations with numerous countries. In addition to the United States, strong connections have been established with countries such as the United Kingdom, Australia, China, Turkey, South Africa, India, and Indonesia. The presence of connections with numerous countries in Europe, Asia, Africa, and Oceania serves to illustrate that digital storytelling research is characterised by a multinational network structure that spans continents. This visual depiction underscores the global dissemination of digital storytelling, its collaborative production paradigm, and the geographical dimension of scientific interaction, thereby complementing the study's map of international collaboration and knowledge flow.

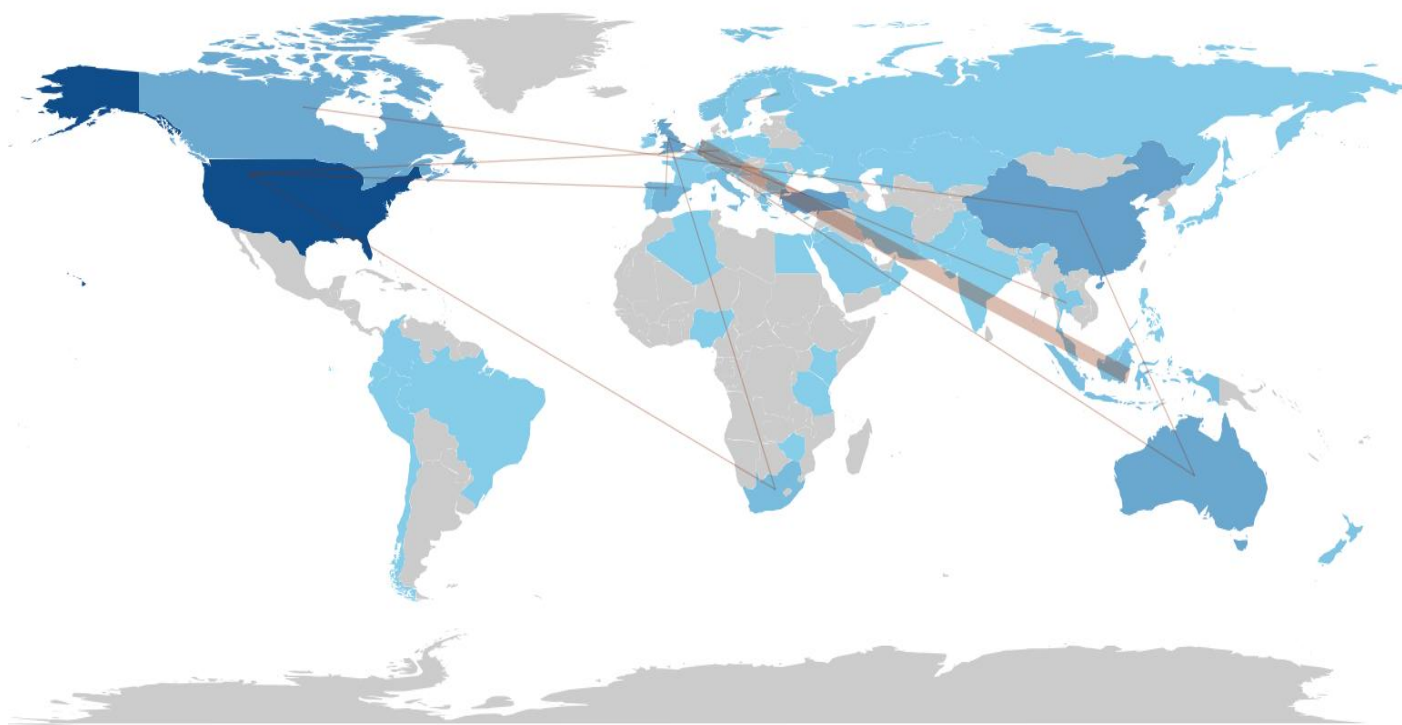


Figure 14. Countries' collaboration world map

CONCLUSION AND DISCUSSION

A bibliometric analysis of 597 articles on 'digital stories' published in the WoS database since 2005 was conducted, and the results obtained are presented in all aspects. Between 2005 and 2025, 597 articles from 270 sources on 'digital stories' were published, with an average of 29.85 articles published per year. The average number of citations per document for these articles is 15.91, and the total number of references is 19,958. The number of Keywords Plus for these articles is 556, and the number of Author's Keywords is 1,633. The number of authors of single-author documents is 156, and the number of authors of multi-author documents is 1,166. The number of single-authored documents is 168, while the number of multi-authored articles is 429. The average number of co-authors per article is 2.53, and the international co-authorship rate is 10.22%.

An examination of the annual distribution of academic studies published on 'digital stories' reveals a marked increase in scientific production in this field over the years. The annual average of studies published with the keyword 'digital stories' was approximately 12.54 between 2005 and 2015. However, it is noteworthy that this average has shown a significant increase since 2016, rising to 45.9 over the period 2016-2025. The year 2024 saw a particularly notable peak in the publication of studies on digital stories, with 71 articles being published. The quantitative data clearly reveal that the digital storytelling approach has been met with increasing interest in the field of education from past to present. This trend is further substantiated by recent studies in the literature (Barber, 2025; Karlin & Kang, 2025; Tsankov & Levunlieva, 2024). The primary factors contributing to this surge include the rapid advancements in digital technologies, the increased adoption of interactive digital tools in educational settings, and the rise in student-centred learning methodologies in contemporary educational practices. Furthermore, the capacity of digital stories to engage multiple senses, their adaptability to individual learning requirements, and their capacity to stimulate creative thinking, have led to sustained interest among researchers in this field.

In this direction, it has been observed that the increasing academic interest in digital storytelling involves not only a quantitative growth but also a qualitative deepening (Jones, 2023). Recent studies have further enriched the literature by focusing on the pedagogical effects of digital storytelling, its interdisciplinary application possibilities and its effects on learning outcomes (Smith et al., 2022). Especially in the context of learner autonomy, motivation and meaningful learning concepts, the contributions of digital stories are frequently emphasised by researchers (Brown, 2021). Consequently, digital storytelling is regarded not solely as a pedagogical instrument but also as a comprehensive learning strategy that is compatible with contemporary learning theories.

However, the practical potential of digital stories also offers significant opportunities for restructuring curricula and transforming teacher training processes. The effective and sustainable integration of this method into classroom practices can be facilitated by supporting teachers in digital story design, media literacy and pedagogical use of multimedia tools (Robin, 2016; Sadik, 2008). Furthermore, the utilisation of digital stories as a pivotal instrument in cultivating adaptable and creative learning environments that are receptive to students' individual differences is anticipated to contribute to the propagation of an inclusive and student-centred educational paradigm. These developments collectively underscore the escalating significance of digital story-based learning in both academic and practical contexts in the future. In this context, further research is expected to provide more in-depth and comparative data on how digital storytelling can be effectively applied in different age groups, disciplines and cultural contexts.

A combined evaluation of thematic maps and thematic evolution analyses derived from the titles, keywords and abstracts of academic studies published on digital stories between 2005 and 2025 reveals a significant increase, particularly after 2020. This phenomenon can be attributed, at least in part, to the global impact of the pandemic caused by the novel coronavirus (SARS-CoV-2), which had consequences for all regions of the world in 2020. This assertion is corroborated by numerous academic studies on educational technologies conducted during and following the pandemic (Chiu, 2020; Guoyan et al., 2021; Roque-Hernández et al., 2021). The rapid proliferation of distance education applications during the pandemic has precipitated a substantial surge in the utilisation of online learning platforms, thereby engendering an augmented demand for digital educational materials. These developments have been effective in increasing interest in the use of digital stories and accelerating research in this field. Digital stories have come to the forefront as tools that offer alternative and innovative solutions to the pedagogical challenges faced by teachers and students under pandemic conditions; in this respect, they have attracted scientific interest.

In the period following the pandemic, there has been an ongoing interest in the digital storytelling approach, with this method being adopted as a permanent pedagogical tool rather than a temporary solution (Jones, 2023). In the process of restructuring education systems, digital stories have been identified as a powerful learning strategy that encourages students' active participation, facilitates emotional connection and supports subjective learning experiences (Smith et al., 2021). In the context of hybrid and online learning environments, studies have demonstrated that digital story-based activities have a positive impact on students' motivation and attitudes towards learning (Yang & Wu, 2022; Barber, 2025). Furthermore, digital stories have been found to make significant contributions to instructional design. These activities have been shown to enhance learning by presenting information in meaningful contexts (Barber, 2025), enriching the learning process with appealing content that engages multiple senses (Yang & Wu, 2022), and providing students with personalised narrative opportunities (Barber, 2025). Consequently, digital storytelling aligns well with contemporary educational theories such as constructivist learning theory, multiple intelligence theory and affective learning approach. Furthermore, the guidance provided by educators during the production of digital stories fosters the development of students' technical abilities and creative thinking capacities. Concurrently, students engage in multifaceted skills such as content research, scriptwriting, and visual and auditory arrangement, thereby engaging in a comprehensive learning process that encompasses both cognitive and affective domains.

This study provides a comprehensive discussion on the place, development and usage potential of digital storytelling in education. A review of the literature reveals that digital stories have gained significant momentum since 2020, a development that is directly related to the increased interest in digital tools in education during the pandemic. Digital stories are regarded as a multifaceted pedagogical tool that enhances learning processes and fosters students' affective and cognitive engagement, transcending its role as a technology-based narrative form. The findings of this study substantiate the considerable potential of digital storytelling in aligning with contemporary educational approaches, its interdisciplinary applicability, and its capacity to promote student-centred teaching methodologies. It has been demonstrated that digital storytelling contributes to the acquisition of 21st-century skills, particularly in terms of enhancing student participation, personalising learning, encouraging creative thinking, and developing digital literacy skills. In this regard, the following recommendations can be put forward:

- The integration of digital storytelling processes into teacher education will enable pre-service teachers to utilise this method effectively for pedagogical purposes. In-service training can encompass topics such as digital story design, scenario creation and digital tool use.

- The integration of digital story applications into various academic disciplines, incorporated within existing curricula, has the potential to facilitate both content learning and the development of students' creative and critical thinking skills.
- It is recommended that further qualitative and quantitative research be conducted on the effects of digital storytelling. Its applicability in different age groups, disciplines and cultural contexts can be systematically examined.
- The provision of technological equipment to educational institutions to facilitate digital story production has the potential to encourage active student and teacher participation in this process.

In conclusion, the digital storytelling approach continues to consolidate its position within educational settings as a flexible and creative teaching strategy that is compatible with the learning styles that are required in the digital age. It is imperative that both teachers and educational policymakers take deliberate steps to ensure the effective and sustainable implementation of this method.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Statements of publication ethics

We declare that the study has no unethical issues and that research and publication ethics have been observed carefully.

Ethics Committee Approval Information

The data for this study were obtained from the WoS database. The sample does not include human participants. A bibliometric analysis was conducted on the literature. Therefore, it is not subject to Ethics Approval.

REFERENCES

- Arevalo, J. A., Alcaraz, J. M., & Shandler, K. (2024). Digital Stories on the Anthropocene: Transforming Student Experiential Learning and Creativity. *Journal of Management Education*, 49(1), 45-88. <https://doi.org/10.1177/10525629241300142>
- Aria, M., & Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959–975. <https://doi.org/10.1016/j.joi.2017.08.007>
- Barber, S. (2025). From silence to academic engagement: How refugee children with disabilities access learning through inclusive 'artful' schools in Canada. *British Educational Research Journal*, 00, 1–31. <https://doi.org/10.1002/berj.4148>
- Barrett, H. (2006, March). Researching and evaluating digital storytelling as a deep learning tool. In *Society for information technology & teacher education international conference* (pp. 647-654). Association for the Advancement of Computing in Education (AACE). https://sscdigitalstorytelling.pbworks.com/f/SITEStorytelling2006_Rubric.pdf
- Biehl, M., Kim, H., & Wade, M. (2006). Relationships among the academic business disciplines: A multi-method citation analysis. *Omega*, 34(4), 359-371. <https://doi.org/10.1016/j.omega.2004.12.002>
- Chiu, T. K. F. (2021). Student engagement in K-12 online learning amid COVID-19: A qualitative approach from a self-determination theory perspective. *Interactive Learning Environments*, 31(6), 3326–3339. <https://doi.org/10.1080/10494820.2021.1926289>
- Cui, K. (2022). Artificial intelligence and creativity: piano teaching with augmented reality applications. *Interactive Learning Environments*, 31(10), 7017–7028. <https://doi.org/10.1080/10494820.2022.2059520>
- Falagas, M. E., Pitsouni, E. I., Malietzis, G. A., & Pappas, G. (2008). Comparison of PubMed, Scopus, Web of Science, and Google Scholar: Strengths and weaknesses. *The FASEB Journal*, 22(2), 338–342. <https://doi.org/10.1096/fj.07-9492LSF>
- Guoyan, S., Khaskheli, A., Raza, S. A., Khan, K. A., & Hakim, F. (2021). Teachers' self-efficacy, mental well-being and continuance commitment of using learning management system during COVID-19 pandemic: a comparative study of Pakistan and Malaysia. *Interactive Learning Environments*, 31(7), 4652–4674. <https://doi.org/10.1080/10494820.2021.1978503>
- Gregori-Signes, C. (2008). Integrating the old and the new: Digital storytelling in the EFL language classroom. *Greta*, 16(1), 43-49. <https://d1wqtxts1xzle7.cloudfront.net/7087145/2008>
- Jakes, D. S., & Brennan, J. (2005). Capturing stories, capturing lives: An introduction to digital storytelling. https://id3432.securedata.net/jakesonline/dst_techforum.pdf
- Jiang, J. (2024). Emotional Landscape of Translingualism: Multilingual International Students Navigating Shame Through Translingual Digital Stories. *TESOL Quarterly*. <https://doi.org/10.1002/tesq.3341>

- Hsiao, J. C., & Chang, J. S. (2023). Enhancing EFL reading and writing through AI-powered tools: design, implementation, and evaluation of an online course. *Interactive Learning Environments*, 32(9), 4934–4949. <https://doi.org/10.1080/10494820.2023.2207187>
- Hobbs, R. (2011). *Digital and media literacy: Connecting culture and classroom*. Corwin Press.
- Karlin, G., & Kang, H. S. (2025). Refugee Learning Center in Indonesia: A Habitat for Refugee Well-Being in Transit. *European Journal of Education*, 60(1), e12926. <https://doi.org/10.1111/ejed.12926>
- Manganello, F., & Baldacci, M. (2024). Digital Stories and Inclusive Cultures at School: A Research Study in an Italian Primary Multicultural Classroom. *Education Sciences*, 14(10), 1108. <https://doi.org/10.3390/educsci14101108>
- Metin, Ş., Kalyenci, D., Başaran, M., Relkin, E., & Bilir, B. (2024). Design-based digital story program: Enhancing coding and computational thinking skills in early childhood education. *Early Childhood Education Journal*, 1-20. <https://doi.org/10.1007/s10643-024-01728-3>
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLOS Medicine*, 6(7), e1000097. <https://doi.org/10.1371/journal.pmed.1000097>
- Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: A comparative analysis. *Scientometrics*, 106, 213–228. <https://doi.org/10.1007/s11192-015-1765-5>
- Nguyen, H. T. T., Dang, V. M. T., & Vu, T. K. C. (2024). An Investigation into Students' Perceptions of Creating Student-generated Digital Videos in PBL at Saigon University. In *Proceedings of the AsiaCALL International Conference* (Vol. 6, pp. 294-309).
- Ohler, J. B. (2013). *Digital storytelling in the classroom: New media pathways to literacy, learning, and creativity*. Corwin Press.
- Ramírez Verdugo, D., & Alonso Belmonte, I. (2007). Using digital stories to improve listening comprehension with Spanish young learners of English. <http://ilt.msu.edu/vol11num1/ramirez/>
- Reinders, H. (2010). Digital storytelling in the foreign language classroom. <https://www.researchbank.ac.nz/server/api/core/bitstreams/c8da7940-5ac2-4e63-802c-5c2945fe0f2b/content>
- Robin, B. (2006). The Educational Uses of Digital Storytelling. In C. Crawford, R. Carlsen, K. McFerrin, J. Price, R. Weber & D. Willis (Eds.), *Proceedings of SITE 2006--Society for Information Technology & Teacher Education International Conference* (pp. 709-716). Orlando, Florida, USA: Association for the Advancement of Computing in Education (AACE). Retrieved March 21, 2025 from <https://www.learntechlib.org/primary/p/22129/>.
- Robin, B. R. (2008b). Digital storytelling: A powerful technology tool for the 21st century classroom. *Theory into Practice*, 47, 220–228. <https://doi.org/10.1080/00405840802153916>
- Robin, B. R., & McNeil, S. G. (2012). What educators should know about teaching digital storytelling. *Digital Education Review*, 22, 37-51. <https://files.eric.ed.gov/fulltext/EJ996781.pdf>
- Roque-Hernández, R. V., Díaz-Roldán, J. L., López-Mendoza, A., & Salazar-Hernández, R. (2021). Instructor presence, interactive tools, student engagement, and satisfaction in online education during the COVID-19 Mexican lockdown. *Interactive Learning Environments*, 31(5), 2841–2854. <https://doi.org/10.1080/10494820.2021.1912112>
- Sadik, A. (2008). Digital storytelling: A meaningful technology-integrated approach for engaged student learning. *Educational technology research and development*, 56, 487-506. <https://doi.org/10.1007/s11423-008-9091-8>
- Tsankov, N., & Levunlieva, M. (2024). Designing Digital Multimodal Resources for the Kindergarten: From Intuition to Awareness. *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE)*, 12(3), 657–667. <https://doi.org/10.23947/2334-8496-2024-12-3-657-667>
- Ulusoy, F. G., & Ulusoy, M. (2024). The effectiveness of students' retellings of and responses to digital stories as a post-viewing activity on their reading attitudes and narrative comprehension. *Education and Information Technologies*, 1-33. <https://doi.org/10.1007/s10639-024-13067-2>
- Valkanova, Y., & Watts, M. (2007). Digital story telling in a science classroom: reflective self-learning (RSL) in action. *Early Child Development and Care*, 177(6–7), 793–807. <https://doi.org/10.1080/03004430701437252>
- Yang, Y. T. C., & Wu, W. C. I. (2012). Digital storytelling for enhancing student academic achievement, critical thinking, and learning motivation: A year-long experimental study. *Computers & education*, 59(2), 339-352. <https://doi.org/10.1016/j.compedu.2011.12.012>
- Xu, M. (2025). Interaction between students and artificial intelligence in the context of creative potential development. *Interactive Learning Environments*, 1–16. <https://doi.org/10.1080/10494820.2025.2465439>
- Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, 18(3), 429–472. <https://doi.org/10.1177/1094428114562629>



| Research Article / Araştırma Makalesi |

The Correlation Between Teacher Agency and Curriculum Literacy

Etken Öğretmenlik ile Öğretim Programı Okuryazarlığı Arasındaki İlişki¹

Ayten Berberoğlu², Ahmet Altındağ³

Keywords

1. Curriculum
2. Teacher agency
3. Curriculum literacy

Anahtar Kelimeler

1. Öğretim Programı
2. Etken öğretmenlik
3. Program okuryazarlığı

Received/Başvuru Tarihi

16.09.2024

Accepted / Kabul Tarihi

25.07.2025

Abstract

Aim: The present study aimed to investigate the correlation between teacher agency and self-perceptions of the teachers about curriculum literacy and to determine whether the impact of curriculum literacy on effective instruction was significant

Design/Methodology/Approach: The study population included 961 teachers employed at public high schools in Bolu province urban center during the 2022-2023 academic year. The study sample included 365 teachers assigned with the convenience sampling method. The present study was conducted with the predictive correlational research design to explore the correlations between the selected variables; curriculum literacy (independent) and teacher agency (dependent). "Teacher Agency Scale" and "Curriculum Literacy Perception Scale" were employed to collect the study data. Statistical analysis of the collected data was conducted with correlation tests and multiple linear regression analysis.

Findings: The study findings revealed that the general perceptions of the teachers about agency and curriculum literacy were high. The correlational analysis indicated that there were positive and significant correlations between the teacher agency (learning agency, teaching agency, optimism, constructive engagement) and curriculum literacy (recognition of the curriculum, implementation of the curriculum, questioning the curriculum, and valuing the curriculum) factors. Regression analysis findings demonstrated that the curriculum literacy sub-dimensions significantly predicted teacher agency.

Öz

Çalışmanın amacı: Bu araştırmanın amacı, öğretmenlerin etken öğretmenlik düzeyleri ile öğretim programı okuryazarlıkları algı düzeyleri arasındaki ilişkinin incelenmesi ve program okuryazarlığının etken öğretmenlik üzerinde anlamlı bir etkisinin olup olmadığını ortaya çıkarmasıdır.

Materyal ve Yöntem: Çalışmanın evrenini 2022-2023 eğitim-öğretim yılında Bolu il merkezinde Milli Eğitim Bakanlığı'na bağlı liselerde görev yapan 961 öğretmen oluşturmaktadır. Çalışmanın örneklemini, uygun örnekleme yöntemiyle belirlenen 365 öğretmen oluşturmaktadır. Araştırmada yordayıcı korelasyonel araştırma deseni kullanılmıştır. Çalışmada veri toplamak amacıyla "Öğretmen Failliği Ölçeği" ve "Öğretim Programı Okuryazarlığı Algı Ölçeği" kullanılmıştır. Elde edilen verinin istatistiki çözümlemeleri için Pearson ve Spearman Korelasyon testleri kullanılmıştır. Bağımsız değişken olan öğretim programı okuryazarlığının bağımlı değişken olan etken öğretmenliği yordama düzeyini tespit etmek amacıyla çoklu regresyon analizi yapılmıştır.

Bulgular: Araştırmanın sonuçlarına göre öğretmenlerin öğretim programı okuryazarlık ve etken öğretmenlik algılarının yüksek olduğu tespit edilmiştir. Öğretim programı okuryazarlığının alt boyutlarından olan programı tanıma, programı hayata geçirme, programa değer verme, programı sorgulama ile etken öğretmenliğin alt boyutları olan öğrenme etkililiği, öğretme etkililiği, iyimserlik ve yapıcı katılım arasında pozitif yönde anlamlı ilişki olduğu görülmüştür. Regresyon analizi sonuçlarına göre, öğretim programı okuryazarlığının alt boyutlarının etken öğretmenliği anlamlı düzeyde yordadığı görülmüştür.

¹ The current paper was based on the master thesis of the first author under the supervision of the second author.

² Ministry of Education, Bolu, Türkiye; <https://orcid.org/0000-0002-0473-7240>, aytenmlik@gmail.com

³ Correspondance Author, Bolu Abant İzzet Baysal University, Faculty of Education, Department of Educational Sciences, Bolu, Türkiye; <https://orcid.org/0000-0001-7192-8031>, ahmetaltindag@ibu.edu.tr

INTRODUCTION

In the current environment of rapid change, teachers are expected to cope with the challenges of change and be willing to cope (Van der Heijden et al., 2015). Transformation of the education system is quite difficult (Trilling & Fadel, 2009). The role of the teacher is prominent in the implementation of change in education. Thus, policies associated with the teachers have been among the most discussed issues in education in recent years. The same trend has been also observed in Turkey. Several regulations and curriculum justifications such as the Teacher Strategy Paper (2017), the General Competencies Framework for the Teaching Profession (2017), the 20th National Education Council (2021), the Law on Teaching Profession (2023) focused on the changes in the role of teachers and it was emphasized that further focus is required for the professional development of teachers.

The Teacher Strategy Document (Ministry of National Education [MEB], 2017) emphasized that teachers play a key role in efforts for change and aimed to ensure continuous personal and professional development of the teachers, improvement of the perceptions about the teaching profession, and strengthening the status of the occupation. The 20th National Education Council decisions addressed the improvement of teacher training and professional development, and recommended several strategies (MEB, 2021). Previous studies reported that the most factor in student achievement was the teacher among scholar factors (Darling-Hammond, 1997). Recognition of the significance of teachers during the implementation of educational reforms, development of local educational policies, and the increase in teacher identity studies led to the introduction and the significance of the concept of 'teacher agency' (Erdem, 2021).

Learning outcomes produced by the curricula that meet international and national standards are evaluated with international exams. The national results in these exams indicate the level of 21st century skills such as literacy, mathematical and scientific proficiency, and problem solving in particular countries. The scores of Turkish students in the exams organized by the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Survey (TIMSS) have been below the OECD averages. This demonstrated that there have been certain incorrect or inadequate policies in the education system. Posner (1995) argued that "Whenever there was a problem in education, the curricula have been altered." Since the Turkish scores were below the OECD country average, it has been considered an indicator and the curricula have been revised. The curricula of 16 primary and 15 secondary education courses were revised since the 2018-2019 academic year. It was argued that "the action plans adopted by the 64th and 65th governments, the international exam results, reports developed by various national and international institutions and organizations, and scientific literature" led to these revisions (MEB, 2020). Curricula could constantly change since these are living documents, and should reflect educational and social changes (Alsubaie, 2016) since the curricula should be consistent with dominant social trends and values (Ellis et al., 1987).

The consistency between the official curriculum developed by the policy makers and the curriculum in practice depends on the implementing teachers. Teachers act like an interface between the official and implemented curricula (Jenkins, 2018). The curricula reflect the changes in needs as well as in teacher training policies. To achieve the curriculum objectives, teachers should be prepared during teacher and in-service training. Due to changes in teacher roles, the teachers no longer transfer knowledge but facilitate learning (Biesta et al., 2015). This paradigm shift necessitates changes in teacher traits.

In recent years, there has been a trend towards teacher-oriented curricula in school-based curriculum development. The trend requires flexible and framework curriculum approach (Akpınar & Aydın, 2007). This trend has not yet been discussed adequately in Turkey. According to PISA 2015 report, the responsibility of the national administration in curriculum development was 77.3% in Turkey, the share of the school board, the school, and local administration in the determination of the educational content was 17.4 %, and that of the teachers was only 5.3%. The OECD average was 44.1%. The lack of teacher participation could explain the below-average student achievement in PISA and TIMSS exams to a certain extent. Contrary to Turkey, teacher participation in curriculum development has increased globally in recent years (Wiles, 2016).

In a constantly and rapidly changing education system due to changing requirements, the new roles of teachers and teacher proficiencies led to discussions on teacher identity. Since instruction agency is a part of teacher identity, the significance of the studies on this topic is evident. According to the ecological model proposed by Priestley et al. (2015) to understand teaching agency, the teachers' personal and professional experiences, short- and long-term goals, and current material, cultural, and structural factors lead to effective instruction. In other words, according to this approach, agency was not considered an innate capacity, but a phenomenon that depends on other factors. It was determined that a focus on the improvement of teachers' skills via teacher policies would not be sufficient, but the policies should also focus on the material, cultural, and structural attributes, namely the practical dimension of education based on the ecological model.

Active teachers participate in curriculum development, implementation, and evaluation (Hill, 2003). In the correlation between teacher agency and curriculum literacy, teacher agency should be improved to achieve the desired student achievements. It was observed that the participation levels of active teachers in professional learning activities are high, and active instruction is important for the effectiveness of scholar development activities that entail the professional development of teachers and student achievements (Liu et al., 2016). Thus, it could be suggested that policy makers should improve not only teacher policies but also other factors.

It has been claimed that the quality and quantity of research and publications on the professional development of teachers in Turkey have been inadequate (Bümen et al., 2012). Thus, the present study on teaching agency and its correlation with curriculum literacy, which has been a topic of debate in professional development of teachers, could contribute to the literature. In the

literature, there are certain studies that investigated each of these variables; however, there is no study that addressed the correlation between them.

The present study aimed to investigate the correlation between teacher agency and curriculum literacy perceptions of the teachers, and to determine whether curriculum literacy had a significant impact on teacher agency. Thus, the research question was determined as follows: "Is there a significant correlation between teacher agency and curriculum literacy?"

1. Is there a significant correlation between teacher agency and curriculum literacy sub-dimensions?
2. Are the curriculum literacy sub-dimensions (curriculum knowledge, implementation, valuation, and questioning) significant predictors of teacher agency?

METHOD

Research Design

The present study that aimed to investigate the correlation between teacher agency levels and curriculum literacy perceptions of the teachers, and to determine whether curriculum literacy had a significant impact on teacher agency, was conducted with the quantitative research method and correlational research design. The aim of the study could be to determine the correlations between certain variables instead of controlling the independent variable similar to empirical studies. Thus, the research was conducted with the correlational approach (Creswell, 2017).

Correlational studies are conducted either to explain significant human behavior or predict possible outcomes (Fraenkel et al., 2022). Thus, two correlational research methods have been developed: explanatory and predictive. In predictive design, the authors attempt to understand the outcomes with certain predictor variables rather than simply determining the correlations between the variables (Creswell, 2017). In the present study, the predictive correlational research design was adopted since it aimed to determine whether curriculum literacy had a significant impact on teacher agency.

Population and Sample

The accessible population of the present study that aimed to investigate the correlation between teacher agency levels and curriculum literacy perceptions of the teachers included 921 teachers employed in public high schools in the Central District of Bolu Province during the 2022-2023 academic year. A review of national and international high school exams revealed significant problems in the academic achievements of the students in the country (Sezgin et al., 2016). Thus, the authors decided to conduct the current study with high school teachers.

The assignment of the study sample depends on variables such as research design, budget, time, and control requirements (Büyükoztürk et al., 2021). It is often difficult, sometimes impossible, to assign a random or systematic non-random sample. In these cases, a researcher could employ the convenience sampling method (Fraenkel et al., 2022). In the current study, the convenience sampling method was adopted since the Bolu Provincial Directorate of National Education allowed scientific studies in certain schools.

Gürbüz and Şahin (2014) determined that to conduct the study within the 95% confidence level and 5% margin of error, the study should be conducted with 278 subjects in a population of 1000. Thus, 375 teachers were contacted in the study. The data collected from 10 teachers out of the 375 teachers were excluded from the analysis since these were invalid, and the analysis was conducted on the data collected from the remaining 365 teachers.

Data Collection Instrument

The present study data were collected with the "Curriculum Literacy Perception Scale (CLPPS)" developed by Keskin (2020) and the "Teacher Agency Scale (TEAS)" developed by Liu et al. (2016) and adapted to Turkish culture by Bellibaş et al. (2019). The psychometric properties of the data collection instruments are included in the next section.

Data Analysis

Initially, the frequencies of the study variables were analyzed to prevent transcription errors during the digitalization of the measurements, and the identified errors were corrected. Furthermore, the data of the participants who provided random responses to the scale questions or did not respond to most items were excluded from the analysis. After the review of the data, missing data and outliers were determined, multivariate normality, multicollinearity, and linear correlations between the variables were analyzed before the CFA analysis to test for the validity of the measurements. First and second level CFA analyses were conducted based on the measurement models described in the original scales. Second level CFA analysis was conducted to evidence the total scale score.

Correlation and multiple linear regression analyses were employed in the study. Cronbach Alpha (α), Stratified Cronbach Alpha and McDonald's Omega (ω) coefficients were calculated to determine the reliability of the measurements. Cohen (1988) threshold presented in Table 3.12 was employed to analyze the correlation. The analyses were conducted with the SPSS (29.0), Jamovi 2, and JASP software. A .05 alpha value was accepted as statistically significant.

FINDINGS

1. Is there a significant correlation between teacher agency and curriculum literacy sub-dimensions?

In this sub-problem, the correlation between the CLPPS and TEAS scores of the teachers was analyzed. Initially, the correlation between the total scale scores was analyzed, and then the correlations between the scale sub-dimensions were analyzed.

Initially, the linearity of the correlation between the total scale scores was investigated. Scatter plots of the total CLPPS and TEAS scores are presented in Figure 1.

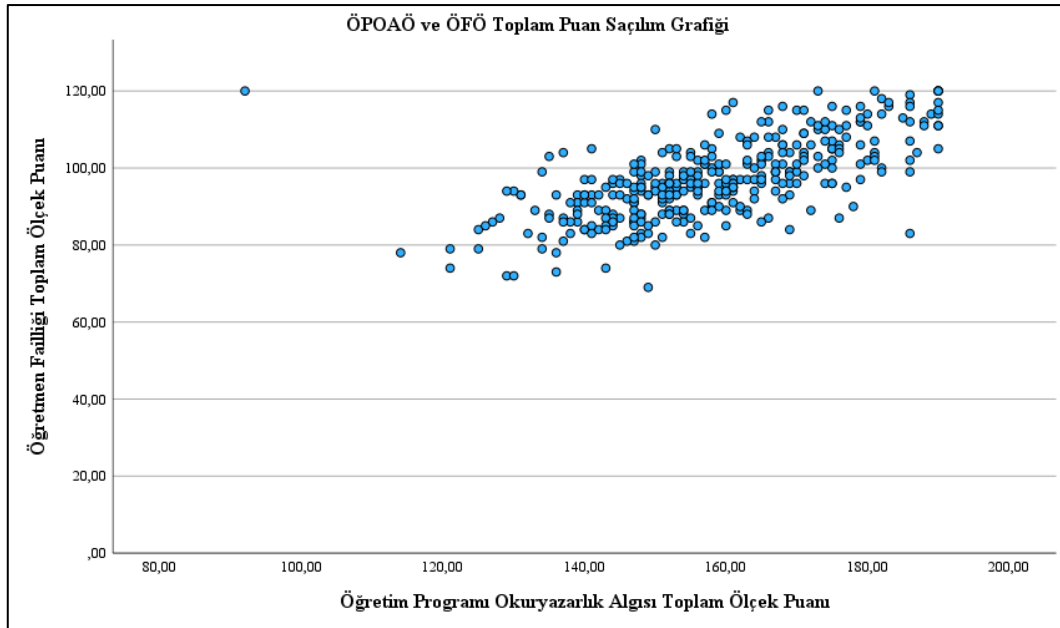


Figure 1. Total CLPPS and TEAS score scatter plot

As seen in Figure 1, there was a linear correlation between the total CLPPS and TEAS scores of the teachers. Furthermore, it was determined that the correlation between the scores suggested covariance. Furthermore, the kurtosis and skewness coefficients of the total scale scores demonstrated that the total scores exhibited normal distribution. Thus, the correlation between the total scale scores was analyzed with the Pearson product-moment correlation coefficient, since it supported the required assumptions. Pearson correlation coefficients for the total CLPPS and TEAS scores are presented in Table 4.5.

Table 1. Pearson correlation coefficients for the total CLPPS and TEAS scores

Variable	1	2
Total CLPPS score	--	,671**
Total TEAS score	,671**	--

**p<,001

As seen in Table 1, there was a statistically significant, high, and positive correlation between the total CLPPS and TEAS scores ($r=.671$; $n=362$; $p<.001$).

Since the CLPPS and TEAS scale subdimension scores did not exhibit normal distribution, the correlations between the sub-dimensions were analyzed with the Spearman's Rank Correlation Coefficient. The correlations between the four CLPPS and TEAS scale sub-dimensions are presented in Table 2.

Table 2. Spearman's Rank Correlation Coefficients for the CLPPS and TEAS scale subdimension scores

Variable	1	2	3	4	5	6	7	8
1. Curriculum knowledge	--							
2. Implementation	,798**	--						
3. Valuation	,725**	,751**	--					
4. Questioning	,677**	,615**	,568**	--				
5. Learning agency	,464**	,475**	,417**	,474**	--			
6. Teaching agency	,549**	,535**	,439**	,492**	,447**	--		
7. Optimism	,357**	,354**	,292**	,360**	,355**	,499**	--	
8. Active participation	,636**	,629**	,504**	,534**	,502**	,619**	,520**	--

**p<,001

As seen in Table 2, the highest positive and statistically significant correlation between the CLPPS subdimensions was between the curriculum knowledge and implementation sub-dimensions ($r=.798$; $n=362$, $p<.001$). The lowest statistically significant correlation was between the valuation and questioning subdimensions ($r=.568$; $n=362$, $p<.001$).

The highest positive and statistically significant correlation between the TEAS subdimensions between the instruction agency and constructive participation ($r=.619$; $n=362$, $p<.001$). The lowest statistically significant correlation was between the learning agency and optimism dimensions ($r=.355$; $n=362$, $p<.001$).

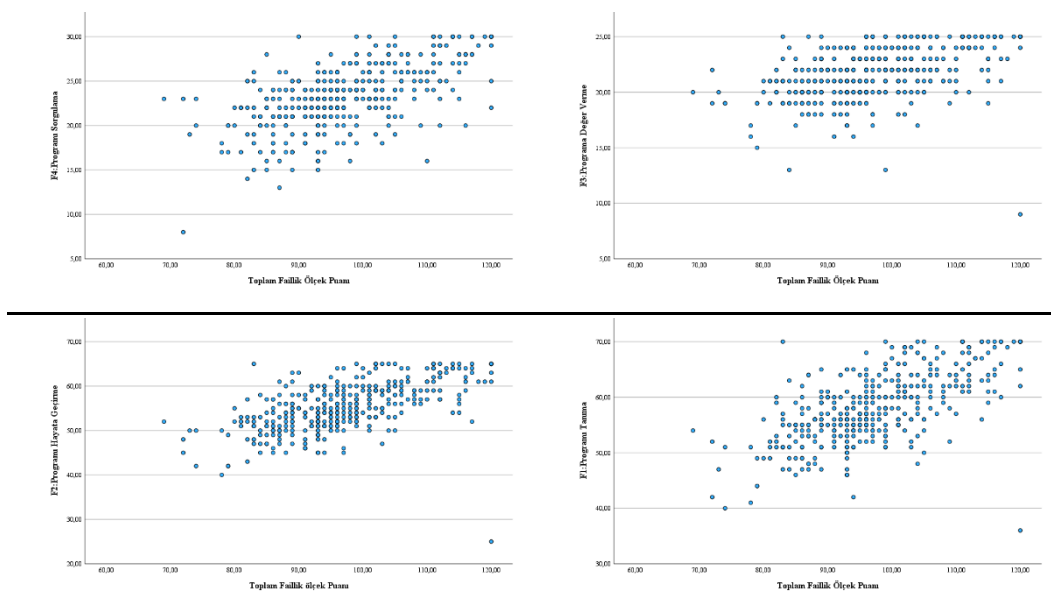
It was observed that the Spearman's Rank Differences between the CLPPS and TEAS sub-dimensions varied between 0.292 and 0.636 and all coefficients were positive and statistically significant ($p<.001$). The highest statistically significant positive correlation was between the constructive participation and curriculum knowledge sub-dimensions ($r=.636$; $n=362$, $p<.001$). The lowest statistically significant positive correlation was between the optimism and valuation sub-dimensions ($r=.292$; $n=362$, $p<.001$).

2. Are the Curriculum Literacy Sub-Dimensions (Curriculum knowledge, Implementation, Valuation, and Questioning) Significant Predictors of the Total Teacher Agency Score?

In this sub-problem, whether the CLPPS subdimensions predicted the total TEAS scale scores was investigated with regression analysis. Initially, the regression analysis requirements and assumptions were tested. Thus, evidence is presented about the independence of observations, the linear correlations between dependent and independent variables, homoscedasticity, multicollinearity, normal distribution of errors, and the significant outlier analysis.

The Durbin-Watson statistics that reflect the independence of observations was calculated as 1.766. A Durbin-Watson statistic of approximately 2 indicates no correlation between the errors. Thus, it could be suggested that the errors were independent. The scatter plot of the linear correlations between the dependent variable, the TEAS total score, and the independent variables, namely the CLPPS sub-dimension scores.

Table 3. Scatter plot of total TEAS scale score and CLPPS sub-dimension scores



As seen in Table 3, there was a linear correlation between the total TEAS score and the curriculum knowledge, implementation, valuation, and questioning dimensions of curriculum literacy. Similarly, regression standard errors histogram and the normal P-P regression standard errors presented in Figure 2 demonstrated that the regression curve errors exhibited an almost normal distribution.

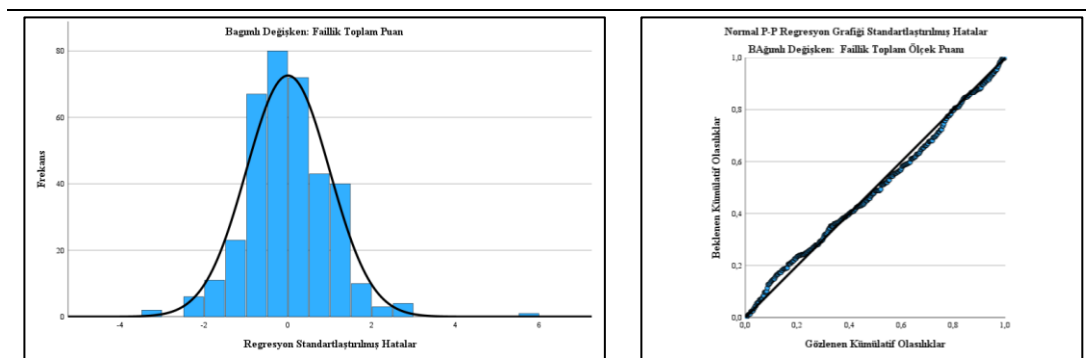


Figure 2. Regression standard errors histogram and the normal P-P regression

Furthermore, homoscedasticity, a significant linear regression assumption, was tested for error variances across all independent variable values. The scatter plot for non-standard prediction errors and standard errors is presented in Figure 3.

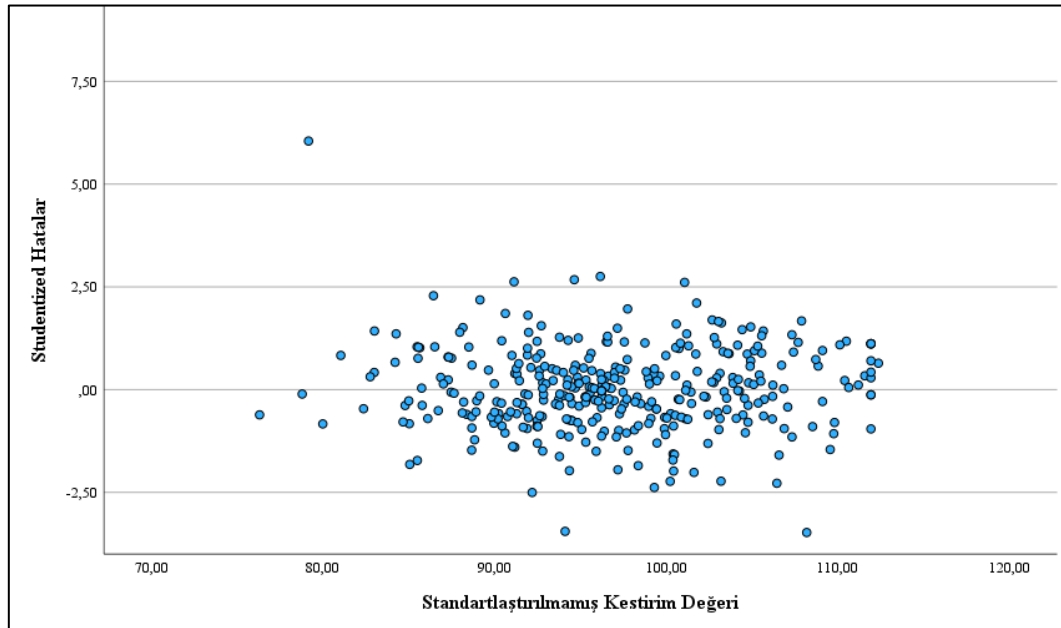


Figure 3. Scatter Plot for Non-standard Prediction Errors and Standard Errors

As seen in Figure 3, the errors exhibited covariance. Since it is another assumption of linear regression, the multicollinearity across the variables was investigated. The calculated Tolerance and VIF values are presented in Table 4.

Table 4. Tolerance and VIF for the dependent variable TEAS and independent variables

Independent variable	Tolerance	VIF
Curriculum knowledge	,271	3,686
Implementation	,272	3,678
Valuation	,380	2,631
Questioning	,572	1,750

As seen in Table 4, the tolerance varied between 0.271 and 0.572, and the VIF varied between 1.750 and 3.686. Hair et al. (2014) suggested that when the tolerance is lower than 0.1 (i.e., when the VIF is greater than 10), there could be multicollinearity. The table demonstrated that the calculations were lower than the reference values and there was no multicollinearity. Thus, it was determined that all multiple linear regression requirements were evidenced.

Multiple linear regression analysis was conducted to determine the prediction power the curriculum knowledge, implementation, valuation, and questioning scores on the total TEAS score. The multiple linear regression ANOVA test findings are presented in Table 5.

Table 5. Multiple linear regression ANOVA findings

Model	Sum of squares	sd	Mean of squares	F	p
Regression	18314,92	4	4578,73	86,06	<,001b
Error	18994,98	357	53,21		
Total	37309,90	361			

As seen in Table 5, the curriculum knowledge, implementation, valuation, and questioning sub-dimensions statistically significantly predicted the total TEAS score [$F(4,357)=86.06$, $p<.001$].

Multiple regression findings for the total TEAS score are presented in Table 6.

Table 6. Multiple regression findings for the total TEAS score

Total TEAS score	B	For B %95 CI		SH B	β	R^2	ΔR^2
		Lower limit	Upper limit				
Model						0,491	0,485
Constant	33,422**	25,578	41,267	3,989			

Total TEAS score	B	For B %95 CI		SH B	β	R^2	ΔR^2
		Lower limit	Upper limit				
Curriculum knowledge	0,593**	0,365	0,822	0,116	0,370**		
Implementation	0,358	0,095	0,621	0,134	0,194		
Valuation	-0,576	-1,093	-0,059	0,263	-0,134		
Questioning	0,936**	0,657	1,214	0,142	0,330**		
Total TEAS score = 33,422 + (0,593 x C. Knowledge) + (0,358 x Implementation) - (0,576x Valuation) + (0,936 x Questioning)							

****p<,001**

It was determined that R^2 of the regression model was 0.491 and the ΔR^2 was 0.485. In other words, the CLPPS sub-dimensions explained 48.5% of the total variance in the TEAS score. According to Cohen (1988), this indicated a large effect size. The non-standard regression coefficients presented in Table 4.10 demonstrated that the constant, curriculum knowledge and questioning variables were statistically significant ($p<.001$). The implementation and valuation sub-dimensions were not statistically significant in the model. However, the confidence intervals for these coefficients demonstrated that they did not include a zero (GAP.Implementation=[0.095; 0.621], GAP.Valuation=[-1.093;-0.059]. Thus, it was determined to keep these factors in the model.

DISCUSSION

The present study aimed to determine the perceptions of high school teachers about their teacher agency and curriculum literacy levels, and the correlation between these two variables. In the present section, the present study findings are compared with the reports in the literature.

In the study, teacher agency was analyzed based on four dimensions: learning agency, teaching agency, optimism and constructive participation of the teacher. Learning agency includes the teacher's efforts in occupational learning and learning even under adverse conditions. Teaching agency includes the teacher's enthusiasm in instruction and leaning of the students. The optimism dimension reflects the teacher's general optimism, a personality trait. The constructive participation dimension is associated with setting goals and the teacher's efforts to achieve these goals.

The study findings associated with the first sub-problem demonstrated a correlation between the perceptions of the teachers about their teacher agency and curriculum literacy levels. The correlation analysis revealed a positive and significant correlation between the curriculum literacy scale sub-dimensions, namely curriculum knowledge, implementation, valuation, and questioning, and teacher agency. Thus, as the teachers knew more, implemented, valued, and questioned the curriculum, their teacher agency improved. It could be suggested that there was a positive and significant correlation between the teacher agency scale and curriculum literacy scale sub-dimensions. The highest correlation was between constructive participation and curriculum knowledge sub-dimensions, and the lowest correlation was between optimism and valuation sub-dimensions.

Aşçı and Yıldırım (2020) investigated the correlation between teacher agency and curriculum commitment and concluded that teachers with high agency exhibited the similar curriculum commitment levels. Although curriculum commitment and teacher agency could be perceived as opposites, they argued that a broad approach could facilitate their implementation. They also argued that the inclusion of teachers in curriculum development would increase the implementation, and their inclusion in the design of the curriculum would improve their agency. Thus, constructive participation could be considered a dimension of teacher agency. Dilek (2020) reported a positive and significant correlation between curriculum literacy of pre-service teachers and their pedagogical knowledge and skills. Since pedagogical knowledge and skills could be considered a dimension of teaching agency, a sub-dimension of teacher agency, it could be suggested that the present study findings were consistent with the above-mentioned finding.

The study findings associated with the second sub-problem demonstrated that curriculum literacy predicted teacher agency. In the regression analysis, the regression table about the predictive power of curriculum literacy on teacher agency was analyzed and interpreted. The curriculum literacy scale subdimension scores statistically significant predicted the total teacher agency scale score. The CLPPS subdimensions explained 48.5% of the total variance in the TEAS score. The regression coefficients demonstrated that the curriculum knowledge and questioning sub-dimensions were statistically significant, while the implementation and valuation sub-dimensions were not statistically significant.

The literature review revealed no empirical study on a direct correlation between teacher perceptions about teacher agency and curriculum literacy. However, theoretical studies suggested a theoretical correlation (Erdem (2021). Empirical studies have been conducted on the curriculum literacy levels of the teachers based on various sub-dimensions. Various variables have been compared in studies on teacher agency. In the present study, it was determined that there was a high, positive, and significant correlation between teacher perceptions about their teacher agency and curriculum literacy levels. When the teachers play a key role in curriculum development, or in "doing" as Priestley et al. (2022) put it, this could positively affect their agency perceptions. Furthermore, this correlation could also be approached from the opposite direction (Priestley et al., 2022). A teacher with high

perceptions about teacher agency would participate more actively in curriculum development and design, which is critical factor in the quality of instructional activities. Due to the duality of the correlation, further studies should be conducted on both concepts to facilitate occupational development of the teachers. This approach could lead to certain changes in undergraduate teacher training. It could also lead the policy makers to prioritize the development of these qualifications in in-service training. Furthermore, the emphasis on the acquisition of these skills by the teachers would allow school administrators to provide an adequate school climate to support personal development of the teachers, which would in turn promote curriculum literacy and teacher agency of the teachers.

An active teacher in the classroom means that the teacher takes actions for change based on the existing conditions. For example, when the current curriculum, material, etc. are not compatible with the student dynamics, the teacher would need to adopt the curriculum. Curriculum literacy is a support instrument in this process. It would allow the teacher to easily identify the problems in the curriculum and benefit from this skill in the implementation and adaptation activities. Thus, the teacher would employ curriculum literacy for teacher agency.

CONCLUSION AND RECOMMENDATIONS

This section includes the findings study and recommendations for future research and applications based on these findings.

1. The present study aimed to investigate the perceptions of high school teachers about teacher agency and curriculum literacy and the correlation between these variables. National literature review revealed only a few studies on teacher agency. The number of studies on curriculum literacy was higher when compared to that of the studies on teacher agency. However, no previous study addressed the correlation between these two concepts.

2. It was concluded that teacher perceptions about agency and curriculum literacy were generally high.

3. The correlation analysis revealed that there was a significant correlation between teacher agency and curriculum literacy.

4. It was also determined that teachers with high curriculum literacy also exhibited high teacher agency perception. This finding was consistent with the findings on the final study sub-problem.

5. Curriculum literacy sub-dimension scores predicted teacher agency.

6. In the study, teacher agency and curriculum literacy findings were based on the perceptions of the teachers; thus, the comparison of these findings with the findings of the studies conducted with different designs would improve the reliability of the study findings. One of the important limitations of the study was the employment of self-report scales. These, the high finding levels should be investigated in future comprehensive qualitative studies.

Based on the above-mentioned findings, the following could be recommended:

1. In-service training programs could be organized to improve the perceptions of the teachers about learning agency.

2. Further incentives could be introduced for teachers to pursue master's and PhD degrees in educational science faculties.

3. An in-service training program could be introduced to improve active participation of the teachers in curriculum development.

4. School administrations could be encouraged to create more participatory school environments to increase teacher participation in the improvement of education and instruction quality at schools.

5. In the present study, the correlation between teacher agency and curriculum literacy perception levels of the teachers employed in public high schools in the central district of Bolu province was investigated. The scope of the study could be expanded and the correlation between teacher agency and curriculum literacy perception levels of primary and secondary school teachers in other provinces could be investigated.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial assistance for the present research, authoring, and/or publication of the present article.

Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Examples of author contribution statements

A.B. and A.A. conceived of the presented idea. A.B. developed the theory and performed the computations. A.B. and A.A. verified the analytical methods. A.A. encouraged A.B. to investigate problem posing and supervised the findings of this work. All authors discussed the results and contributed to the final manuscript.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

The study was approved by the Bolu Abant İzzet Baysal University Social Sciences Ethics Committee (No: 2022-385; date: 26.10.2022).

REFERENCES

- Akpınar, B., & Aydın, K. (2007). Türkiye ve bazı ülkelerin eğitim reformlarının karşılaştırılması. *Fırat Üniversitesi Doğu Araştırmaları Dergisi*, 6(1), 82-88.
- Alsubaie, M. A. (2016). Curriculum development: Teacher involvement in curriculum development. *Journal of Education and Practice*, 7(9), 106-107.
- Aşçı, M. and Yıldırım, R. (2020). Öğretmen failliği ile öğretim programına bağlılık arasındaki ilişki: Yunus Emre ilçesi örneği. *OPUS International Journal of Society Researches*, 16 (Eğitim ve Toplum Özel sayısı), 6126-6149. <https://doi.org/10.26466/opus.806477>
- Bellibaş, M. Ş., Çalışkan, Ö. and Gümüş, S. (2019). Öğretmen failliği ölçeğinin geçerlik ve güvenirlik çalışması. *Trakya Eğitim Dergisi*, 9(1), 1-11.
- Biesta, G., Priestley, M., & Robinson, S. (2015). The role of beliefs in teacher agency. *Teachers and Teaching*, 21(6), 624-640. <https://doi.org/10.1080/13540602.2015.1044325>
- Bümen, N. T., Alev, A., Çakar, E., Gonca, U. , & Veli, A. (2012). Türkiye bağlamında öğretmenlerin mesleki gelişimi: Sorunlar ve öneriler. *Milli Eğitim Dergisi*, 42(194), 31-50.
- Büyükoztürk, Ş., Kılıç-Çakmak, E., Akgün, Ö., Karadeniz, Ş., & Demirel, F. (2021). Bilimsel araştırma yöntemleri. 30.baskı, Ankara: Pegem Akademi.
- Creswell, J. W. (2017). Eğitim araştırmaları: Nicel ve nitel araştırmanın planlanması, yürütülmesi ve değerlendirilmesi. İstanbul: Edam.
- Darling-Hammond, L. (1997). The quality of teaching matters most. *Journal of Staff Development*, 18(1), 38-41
- Dilek, Ç. (2020). Öğretmen adaylarının program okuryazarlık düzeyleri ile pedagojik bilgi ve beceri düzeylerinin incelenmesi (Master's thesis). Fırat University, Elazığ.
- Ellis, A. K., Mackey, J. A. & Glenn, A. D. (1987). The school curriculum. Boston: Allyn & Bacon.
- Erdem, C. (2021). Etkin öğretmenliğin inşasında temel bir yeterlik olarak eğitim programı okuryazarlığı. Y. Bolat (ed.), Eğitim programı okuryazarlığı (ss. 59-76). Ankara: Pegem Akademi.
- Fraenkel, J., Wallen, N., & Hyun, H. (2022). How to design and evaluate research in education (11th ed.). New York: McGraw-Hill.
- Gürbüz, S., & Şahin, F. (2014). Sosyal bilimlerde araştırma yöntemleri. Ankara: Seçkin Yayıncılık.
- Hill, H. C. (2009). Fixing teacher Professional development. *Phi Delta Kappan*, 90(7), 470-476.
- Jenkins, G. (2020). Teacher agency: The effects of active and passive responses to curriculum change. *The Australian Educational Researcher*, 47(1), 167-181. <https://doi.org/10.1007/s13384-019-00334-2>
- Keskin, A. (2020). Öğretmenlerin öğretim programı okuryazarlık düzeylerine yönelik algılarının belirlenmesi (PhD thesis). Hacettepe University, Ankara.
- Liu, S., Hallinger, P., & Feng, D. (2016). Supporting the professional learning of teachers in China: Does principal leadership make a difference?. *Teaching and teacher education*, 59, 79-91. <https://doi.org/10.1016/j.tate.2016.05.023>
- Milli Eğitim Bakanlığı (MEB). (2017a). Öğretmen strateji belgesi 2017-2023. https://oygm.meb.gov.tr/meb_iys_dosyalar/2017_07/26174415_strateji_Belgesi_RG-26.07.2017.pdf
- Milli Eğitim Bakanlığı (MEB). (2017b). Öğretmenlik mesleği genel yeterlikleri. https://oygm.meb.gov.tr/meb_iys_dosyalar/2017_12/11115355_YYRETMENLYK_MESLEYY_GENEL_YETERLYKLERY.pdf
- Milli Eğitim Bakanlığı (MEB). (2020). Öğretim programlarını değerlendirme raporu. https://ttkb.meb.gov.tr/meb_iys_dosyalar/2020_08/24113242_ogretimprogramlari_dr.pdf
- Milli Eğitim Bakanlığı (MEB). (2021). 20. Milli eğitim şurası kararları. http://ttkb.meb.gov.tr/meb_iys_dosyalar/2021_12/08163100_20_sura.pdf
- Posner, G. J. (1995). *Analyzing the Curriculum* (2nd ed.). New York: McGraw-Hill.
- Priestley, M., Edwards, R., Priestley, A., & Miller, K. (2012). Teacher agency in curriculum making: Agents of change and spaces for manoeuvre. *Curriculum inquiry*, 42(2), 191-214. <https://doi.org/10.1111/j.1467-873X.2012.00588.x>
- Priestley, M., Biesta, G., & Robinson, S. (2015). Teacher agency: what is it and why does it matter?. In J. Evers & R.Kneyber (Eds.), *Flip the system* (pp. 134-148). London: Routledge.
- Sezgin, F., Koşar, D., Koşar, S., & Emre, E. R. (2016). Liselerde akademik başarısızlık: Nedenleri ve önlenmesine ilişkin öğretmen ve okul yöneticilerinin görüşleri. *İnönü Üniversitesi Eğitim Fakültesi Dergisi*, 17(1), 0-0. <https://doi.org/10.17679/iuefd.17119535>
- Trilling, B., & Fadel, C. (2009). *21st century skills: Learning for life in our times*. New York: John Wiley & Sons.
- Van der Heijden, H. R. M. A., Geldens, J. J., Beijaard, D., & Popeijus, H. L. (2015). Characteristics of teachers as change agents. *Teachers and Teaching*, 21(6), 681-699. <https://doi.org/10.1080/13540602.2015.1044328>



| Research Article / Araştırma Makalesi |

The Impact of Design-Based Research Method Science Activities on Middle School Students' Creative and Critical Thinking Skills: A Classroom Experimental Study

Tasarım Tabanlı Araştırma Yöntemi ile Hazırlanan Fen Etkinliklerinin Ortaokul Öğrencilerinin Yaratıcı ve Eleştirel Düşünme Becerilerine Etkisi: Sınıf İçi Deneysel Uygulama Çalışması

Adem YILMAZ¹

Keywords

1. Tasarım Tabanlı Araştırma
2. Deneysel Uygulama
3. Fen Eğitimi
4. Yaratıcı Düşünme
5. Eleştirel Düşünme

Anahtar Kelimeler

1. Design-Based Research
2. Experimental Implementation
3. Science Education
4. Creative Thinking
5. Critical Thinking

Received/Başvuru Tarihi
24.03.2024

Accepted / Kabul Tarihi
25.07.2025

Abstract

Purpose: The purpose of this study is to investigate the effect of science activities prepared through the design-based research (DBR) method on middle school students' creative and critical thinking skills.

Design/Methodology/Approach: A quasi-experimental design was employed. The study group consisted of 80 middle school students in Kastamonu, Turkey, randomly assigned to experimental and control groups. Design-based science activities were applied in the experimental group, while the control group followed traditional science instruction. Data were collected through pre-tests and post-tests using the Marmara Creative Thinking Dispositions Scale and Marmara Critical Thinking Dispositions Scale.

Findings: Results indicated significant improvements in creative and critical thinking dispositions of students in the experimental group compared to the control group. The DBR activities provided students with active problem-solving opportunities, enhancing their ability to generate creative ideas and critically evaluate their work.

Highlights: The study highlights that the design-based research approach in science education is more effective than traditional teaching methods in enhancing creative and critical thinking skills. It is recommended for educators and curriculum developers to integrate DBR-driven activities into educational programs.

Öz

Çalışmanın amacı: Bu çalışmanın amacı, tasarım tabanlı araştırma yöntemiyle hazırlanan fen etkinliklerinin ortaokul öğrencilerinin yaratıcı ve eleştirel düşünme becerilerine olan etkisini incelemektir.

Materyal ve Yöntem: Araştırma, yarı deneysel desen kullanılarak gerçekleştirilmiştir. Kastamonu ilinde öğrenim gören 80 ortaokul öğrencisi rastgele seçilerek deney ve kontrol gruplarına ayrılmıştır. Deney grubunda tasarım tabanlı fen etkinlikleri uygulanırken, kontrol grubu geleneksel fen öğretimine devam etmiştir. Uygulama öncesi ve sonrası Marmara Yaratıcı Düşünme Eğilimleri Ölçeği ve Marmara Eleştirel Düşünme Eğilimleri Ölçeği kullanılarak veri toplanmıştır.

Bulgular: Araştırma sonucunda, deney grubundaki öğrencilerin yaratıcı ve eleştirel düşünme eğilimlerinde kontrol grubuna kıyasla anlamlı düzeyde daha fazla gelişim gösterdiği belirlenmiştir. Tasarım tabanlı etkinliklerin öğrencilere aktif problem çözme fırsatları sunduğu ve bu süreçte yaratıcı fikir üretme ile eleştirel değerlendirme becerilerini geliştirdikleri gözlenmiştir.

Önemli Vurgular: Araştırma bulguları, tasarım tabanlı araştırma yönteminin fen eğitiminde yaratıcı ve eleştirel düşünme becerilerini geliştirmede geleneksel yöntemlerden daha etkili olduğunu ortaya koymaktadır. Bu bağlamda, eğitimciler ve program geliştiricilere tasarım tabanlı etkinliklerin eğitim programlarına entegrasyonu önerilmektedir.

¹ Corresponded Author, Kastamonu University, Faculty of Education, Division of Science Education, Kastamonu, Türkiye, <https://orcid.org/0000-0002-1424-8934>

INTRODUCTION

In the 21st century, rapid advancements in technology, science, and globalization have made it imperative for individuals to be equipped with high-level cognitive skills such as creative thinking and critical thinking (National Science Teaching Association [NSTA], 2013). In an era where information is abundant and challenges are complex, mere content knowledge is not sufficient; students need to develop the ability to generate innovative solutions and make well-reasoned decisions (Bybee, 2010; Trilling & Fadel, 2009). Consequently, modern educational frameworks emphasize creative and critical thinking among the core “21st-century skills,” alongside communication, collaboration, and other key competencies (National Research Council [NRC], 2010; Partnership for 21st Century Skills [P21], 2009). These skills are considered essential not only for academic success but also for enabling students to adapt and contribute effectively to today’s knowledge-based and rapidly changing society. Science education plays a pivotal role in fostering 21st-century skills. Quality science instruction inherently provides a context for students to engage in problem solving, critical thinking, and information literacy, thereby helping them develop broadly applicable thinking habits. The U.S. National Research Council and the Partnership for 21st Century Learning have highlighted that science education reform and 21st-century skills share complementary goals: while science education seeks to promote deep understanding through active inquiry, 21st-century skills initiatives focus on cultivating adaptable, innovative thinkers prepared for the modern workforce (NSTA, 2013). Indeed, exemplary science education can offer rich opportunities for students to hone skills like critical thinking and creativity in tandem with scientific content mastery. Equipping learners with these skills has a dual benefit: it prepares a well-qualified future workforce and also endows individuals with life skills that enhance their personal decision-making and success in daily life. In summary, creative and critical thinking have emerged as universal educational priorities in the 21st century, regarded as indispensable for learners to navigate complex information, innovate, and participate meaningfully in civic life (Organisation for Economic Co-Operation and Development [OECD], 2018).

Science Education and Cognitive Skills at the Middle School Level

At the middle school level, science education is crucial not only for imparting scientific knowledge but also for developing students’ cognitive skills. In Türkiye, the science curriculum begins in 3rd grade and continues through middle school (5th–8th grades), aiming to foster scientific literacy from an early age (Ministry of National Education [MoNE], 2018). The 2018 revised Science Curriculum in Türkiye explicitly emphasizes moving beyond rote learning of facts to focus on cultivating students’ higher-order thinking skills. Among its objectives, the curriculum highlights the development of students’ creative thinking, critical thinking, problem-solving, and decision-making abilities through science learning experiences (MoNE, 2018; NRC, 2010). In particular, new elements such as *Engineering and Design Applications* in the curriculum encourage students to apply scientific concepts by designing innovative solutions or products, thereby integrating opportunities for creativity within science lessons. Science classes inherently engage students in scientific process skills, providing a natural avenue for exercising advanced thinking. Activities like making observations, asking questions, formulating hypotheses, designing experiments, collecting data, and drawing conclusions train students to think both analytically and critically. For instance, in attempting to solve a scientific problem, a student begins by posing questions and hypothesizing (applying critical analysis to define the problem), then conducts experiments to gather evidence and interprets the results. Throughout this investigative process, students employ critical thinking to evaluate data and validate their hypotheses, and simultaneously use creative thinking to devise hypotheses and imagine explanations for their observations. In fact, scientists themselves rely on both creative and critical thinking when seeking solutions to scientific problems; they generate novel ideas and approaches, then rigorously test and refine them (Aguilera-Hermida, 2020). Thus, science education offers students the chance to “think like a scientist,” integrating imaginative idea generation with evidence-based reasoning, which in turn nurtures both creative and critical faculties. Historically, however, science instruction has not always realized this dual potential. Traditional science teaching methods often centered on content delivery and memorization, giving relatively little attention to developing students’ critical thinking. Many education systems, including Türkiye’s in past decades, have been critiqued for focusing on factual recall in science classes at the expense of inquiry and reasoning skills. In recent years, educational reforms and updated curricula have aimed to address this gap by enriching science lessons with inquiry-based and student-centered activities that target skills like questioning, investigation, and creativity (MoNE, 2018). As Hacıoğlu and Kutru (2021) noted, science learning environments are seen as a prime opportunity to cultivate individuals who can keep up with scientific and technological advancements and who possess creative thinking abilities. This shift reflects a growing recognition that science education is not solely about learning scientific facts; it is equally about laying the foundation for scientific thinking, innovative problem-solving, and a critical mindset in students. By engaging with scientific content through experimentation and problem-solving, middle school students can concurrently develop cognitive skills that will serve them across disciplines and in real-world contexts.

Design-Based Research Method in Education and Its Connection to Science Teaching

The Design-Based Research (DBR) method is an innovative research approach in education that blends theoretical inquiry with practical implementation. Known in Turkish as “Tasarım Tabanlı Araştırma (TTA) Yöntemi,” DBR involves researchers systematically designing educational interventions and studying their impact in real-world settings. The fundamental process of DBR consists of developing a solution or intervention (such as a set of learning activities or a curriculum unit) to address a specific educational problem, implementing this intervention in an authentic context (e.g., a classroom), and then iteratively refining the design based on empirical findings. Unlike one-off experiments, DBR is characterized by iterative cycles of design, enactment, analysis, and

redesign. In each iteration, data on how the intervention affects learning are collected and analyzed, and the insights gained are used to improve the intervention in the next cycle (Collins, 1992; Wang & Hannafin, 2005). This iterative refinement continues until the educational innovation meets both its practical goals and generates sufficient data to allow researchers to draw conclusions about learning processes and outcomes. A hallmark of design-based research is the close collaboration between researchers and practitioners (teachers). In DBR, researchers often work hand-in-hand with classroom teachers to develop and implement interventions, ensuring that the innovations are feasible and relevant to everyday teaching practice. This collaboration allows for immediate identification and resolution of issues that arise during implementation, making the research process responsive and grounded in classroom reality (Design-Based Research Collective, 2003). By bridging the gap between theory and practice, DBR serves as a conduit for producing knowledge that is both scientifically valid and educationally useful. The approach aims to yield practical solutions for educators while simultaneously contributing to theory by uncovering design principles and refining learning theories based on what works (or doesn't work) in practice. In fact, the literature notes that a key goal of DBR is to develop new theories or frameworks for understanding learning and instruction that emerge from successful designs. In other words, through the DBR process, researchers seek to generate empirically grounded insights into how and why a particular educational innovation succeeds, thus informing broader educational research and practice.

Design-based research methodology emerged in the 1990s (Collins, 1992) as "design experiments" and has since gained traction in various fields of education. In the context of science education, DBR has been widely adopted to design and test innovative teaching approaches aimed at improving student engagement and understanding. For example, in science education literature, a DBR-oriented pedagogical approach is sometimes referred to as "design-based science" (Fortus et al., 2005; Vattam & Kolodner, 2006), which involves students using their scientific knowledge to develop an artifact or solve a real-world problem through design. In such approaches, students might be given a challenge (e.g., design a water filtration system or build a model rocket) that requires them to apply scientific concepts in a creative way. As they work on the design task, they engage in inquiry: they test their prototypes, observe outcomes, troubleshoot issues, and iteratively improve their designs. This process mirrors professional scientific and engineering practices and, importantly, situates learning in a meaningful problem-solving context. DBR in science education thus often produces curriculum interventions that are project-based or problem-based, where learning happens as students design and create, rather than passively absorb information. The role of DBR in education is significant because it allows researchers to tackle the complexity of learning environments head-on. Traditional experimental methods attempt to isolate variables to determine cause-effect relationships, but learning in classrooms is influenced by an interplay of many factors (student background, teacher practices, social dynamics, etc.) (Baron & Daniel-Allegro, 2019). DBR embraces this complexity by treating the classroom as a holistic "learning ecology" to be improved and studied simultaneously. By implementing and refining interventions in situ, DBR acknowledges emergent variables and adapts to them, yielding findings that are directly applicable to practice. In science classrooms, this might mean that a DBR study not only measures test score gains from a new teaching method but also observes how student motivation, classroom discourse, and practical constraints interact with the method. The knowledge gained is thus context-sensitive and immediately relevant to practitioners. Over time, DBR studies in science education have contributed to our understanding of effective strategies, such as how to integrate technology in science labs or how to sequence inquiry activities for optimal learning (Barab & Squire, 2004; Sandoval, 2014). In summary, design-based research is a contemporary and powerful approach in science education research, enabling the development of effective instructional practices and providing deep insights into student learning by iteratively testing and refining educational designs in real classrooms.

Creative and Critical Thinking Skills: Definitions and Educational Relevance

Creative thinking and critical thinking are two interrelated higher-order thinking skills that are prominently valued in modern education. Creative thinking is typically defined as the capacity to produce novel and useful ideas or products. This definition emphasizes two key aspects: originality (novelty) and appropriateness or value (usefulness). For instance, psychology professor Michael Mumford summarized the consensus in creativity research by stating, "*creativity involves the production of novel, useful products*" (Mumford, 2003, p.110). Similarly, Sternberg and Sternberg (2011) noted that creativity yields "*something original and worthwhile*" (Sternberg & Sternberg, 2011). E. Paul Torrance (1966) described creativity as a process that involves becoming aware of problems or gaps in knowledge, identifying difficulties, searching for possible solutions, testing and retesting these solutions, and finally communicating the results. Despite varying formulations, most definitions converge on the idea that creative thinking enables individuals to approach situations in innovative ways and generate outcomes that are not only new but also effective or valuable. In an educational context, creative thinking might manifest when a student comes up with an original hypothesis for a science experiment, devises an unconventional method to solve a math problem, or composes an imaginative story in language arts. This skill is crucial because it drives innovation and adaptability; students who think creatively are better prepared to tackle novel challenges and contribute original ideas in their future careers and daily lives.

Critical thinking, on the other hand, refers to the process of analyzing, evaluating, and synthesizing information in a disciplined and logical manner to guide one's beliefs or actions. A widely cited definition by Ennis (1991) describes critical thinking as "reasonable, reflective thinking focused on deciding what to believe or do." Likewise, Facione (1990) defines it as purposeful, self-regulatory judgment which entails interpretation, analysis, evaluation, and inference, as well as explanation of the evidential and conceptual bases of one's decisions. In simpler terms, critical thinking involves skills such as analysis (breaking down complex information into parts), evaluation (assessing the credibility and relevance of information or arguments), and inference (drawing

logical conclusions). A critical thinker carefully considers evidence, questions assumptions, identifies biases, and thinks through the implications of decisions. In education, fostering critical thinking means encouraging students to not just accept information at face value, but to question, investigate, and reason (Geitz & de Geus, 2019). For example, a critically thinking student in a science class will examine data from an experiment and consider whether the data truly support the conclusion, or a student in a social studies class will evaluate the credibility of different sources before forming an opinion on a historical event. Critical thinking is essential for enabling students to become independent learners and informed citizens. It empowers them to make reasoned decisions in everyday life, from scrutinizing the validity of news articles to solving complex problems in the workplace (Halpern, 2013).

Both creative and critical thinking are crucial in education because they correspond to the demands of the contemporary world (Ayyıldız & Yılmaz, 2023). Creativity is often called the engine of innovation – economies and societies thrive on individuals who can devise new solutions and drive progress. Teresa Amabile and colleagues have highlighted creativity as a critical skill for the workforce of the future, noting that companies across fields prioritize employees who can think outside the box to spur innovation (Amabile & Pratt, 2016). In science and technology, creative thinking leads to breakthroughs and new inventions; in everyday life, it enables people to adapt to change and find alternatives when faced with obstacles. Critical thinking, likewise, is fundamental for navigating the information-rich and often complex societal landscape of today. It allows individuals to discern truth from misinformation, to participate in reasoned discourse, and to make decisions that are rational and evidence-based. As Yacoubian (2015) argues, incorporating aspects of the Nature of Science and socioscientific issues in schooling is important because it links science learning to critical thinking, helping students learn to make informed decisions on issues that affect society (Santos, 2017). For example, on topics like climate change or public health, critical thinking enables students to weigh scientific evidence, understand the interplay of scientific and ethical considerations, and come to well-founded positions. In democratic societies, citizens with strong critical thinking skills are better equipped to engage in debates, understand public policies, and vote or act in ways that align with informed judgment rather than ignorance or bias. It is important to note that creative and critical thinking are not opposing skills, but rather complementary processes in thinking and problem-solving. Creativity involves generating ideas, while critical thinking involves judging ideas; effective problem solving and decision making typically require both. In a complex task, one often cycles between divergent thinking (brainstorming multiple possibilities) and convergent thinking (critically narrowing down options and selecting the best course). Educational psychologists often view these two skills as part of an “integrated thinking” model (Baum-Combs, Cennamo & Newbill, 2009). For instance, when students engage in a project-based learning activity, they use creative thinking to propose various project ideas or hypotheses, and then apply critical thinking to test their hypotheses or evaluate which idea is most feasible. Over the course of such an activity, learners must regulate their thought process—maintaining an open mind to new ideas while also applying logical criteria to refine those ideas. Therefore, modern pedagogical approaches aim to cultivate both creative and critical thinking in tandem, recognizing that a well-developed thinker needs to be inventive yet also judicious. By encouraging students to brainstorm and then analyze, to create and then critique, educators help students build a robust thinking repertoire that prepares them for complex real-life tasks.

Impact of Design-Based Research (Design-Focused) Interventions on Creative and Critical Thinking

Existing research suggests that learning environments structured around design principles – often developed through design-based research – can have positive effects on students’ creative and critical thinking skills. Educational interventions prepared using the DBR approach usually involve students in active problem-solving and creation, which inherently engages their creativity and critical reasoning. Studies have documented that when students participate in design-based learning activities in science, they often show improvements in creative thinking. For example, Azizan and Shamsi (2022) investigated an online design-based learning experience with undergraduate science students and found that this approach enhanced students’ creativity, allowing them to “think outside the box”. Participants reported that having to develop an artifact to solve a real-life problem encouraged them to generate more original ideas and approach problems more imaginatively. Similarly, Joordens et al. (2012) note that design-based learning scenarios can boost students’ imaginative capacity and creative engagement by placing them in open-ended problem contexts where innovative thinking is required. These findings support the notion that giving students the challenge and freedom to design solutions leads to measurable gains in creative thinking skills such as fluency (producing many ideas) and flexibility (producing diverse ideas) (Azizan & Shamsi, 2022). In tandem, research indicates that critical thinking skills are also bolstered by design-oriented science activities. When students are involved in design tasks, they must not only invent ideas but also continually evaluate and refine those ideas, which is a form of critical thinking in action. For instance, during a design project, students often present their creations or solutions to peers and instructors, defend their design decisions, and respond to feedback or questions. This process requires them to articulate reasoning, consider counter-arguments, and justify their choices with evidence, thereby exercising and improving their critical thinking. Doppelt (2006) and Zhang et al. (2021) found in their studies on design-based science learning that having students present and defend their design projects led to significant enhancements in their critical thinking and problem-solving abilities. In these studies, students who engaged in design-and-defense activities became more adept at argumentation – they learned to provide logical justifications for how their design meets certain criteria or solves the problem, reflecting growth in critical analysis skills. Moreover, such activities often demand that students troubleshoot design flaws or optimize solutions, which involves a cycle of identifying weaknesses (critical evaluation) and improving the design (creative problem-solving). Through these experiences, students practice evidence-based reasoning and learn to view their own work through a critical lens, asking “What works? What doesn’t? And why?”. In short, design-centric learning experiences tend to treat creativity and critical thinking as intertwined: students use creativity to propose ideas and

critical thinking to test and refine those ideas, leading to improvement in both skill sets. The synergy between design-based approaches and higher-order thinking has been articulated in theoretical models as well. Baum-Combs, Cennamo and Newbill (2009) proposed a conceptual model linking design-based learning environments to the development of creative and critical thinking. In their model, the problem space (where a learner defines and analyzes the problem) and the solution space (where the learner ideates and prototypes solutions) overlap in a cyclic process, and the student continually engages in self-regulation to monitor and adjust their approach. In practice, this means a student might repeatedly alternate between divergent phases (brainstorming design ideas) and convergent phases (critiquing and selecting ideas to implement). The model underscores that design thinking lies at the heart of both creative and critical thought – design is a unique form of problem-solving with no predetermined correct answer, requiring the generation of original ideas as well as the evaluation of those ideas against constraints and criteria. Hence, a well-designed educational activity grounded in DBR principles inherently fosters an environment where students must employ creative generation of ideas and critical judgment continuously. The relationship between critical thinking, creative thinking, and design is presented in Figure 1.

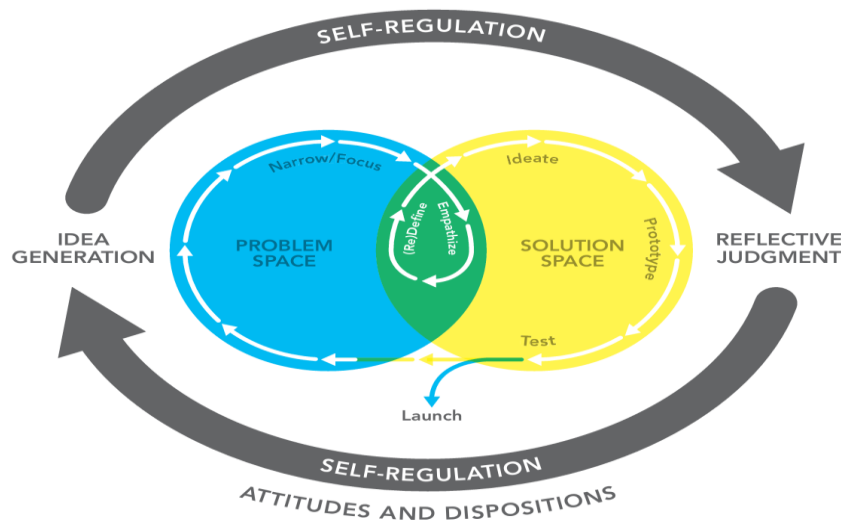


Figure 1. Number of Theses Written by Year (URL-1, 2025)

In summary, design-based research interventions in science education – such as science activities crafted through iterative design and implemented in classrooms – tend to create a learning experience that is conducive to both creativity and critical thinking. The hands-on, minds-on nature of these activities means that students are not passively receiving information; instead, they are actively creating and critiquing knowledge. Research to date shows that students immersed in such environments are able to propose more innovative ideas and also evaluate those ideas more thoroughly compared to students in more traditional settings (Azizan & Shamsi, 2022; Yilmaz, 2021). They learn to embrace failure as feedback, viewing setbacks in their design as prompts to think harder or differently – a disposition characteristic of both creative resilience and critical open-mindedness. Consequently, design-based learning activities help students practice the full cycle of thinking: from conception of an idea to its execution and evaluation. These experiences strengthen their ability to approach any complex task with both a creative spark and a critical eye.

Significance and Objectives of the Research

Despite the promising findings in the literature, there is a noticeable gap when it comes to studies focusing on the impact of design-based research (DBR) driven science activities on middle school students' creative and critical thinking skills, particularly in the Turkish context. Many existing studies internationally have been conducted at the high school or undergraduate level, or they have focused on outcomes like content learning and attitude rather than explicitly on thinking skills. Middle school is a formative period for cognitive development; thus, examining interventions at this stage can provide insight into how early engagement with design-based learning might influence students' thinking trajectories. This research aims to address the gap by investigating the effect of science activities prepared using the design-based research method on the creative and critical thinking skills of middle school students in Türkiye. In doing so, it seeks to contribute both to the local educational literature and to the broader understanding of how design-oriented pedagogy can support 21st-century skills in younger learners. The significance of this study can be articulated in several ways: Firstly, it will empirically evaluate to what extent the goals of the 2018 Turkish science curriculum regarding creative and critical thinking can be achieved through an innovative methodological approach (DBR-designed activities). This provides valuable feedback on curriculum implementation and the effectiveness of pedagogical innovations in reaching desired skill outcomes. Secondly, by implementing a design-based research approach in actual middle school classrooms and measuring its impact, the study will yield insights into the practical benefits and challenges of this approach at the middle school level. Specifically, it will shed light on whether such DBR-informed interventions measurably enhance students' creative and critical thinking in our local context, aligning with what has been observed elsewhere. Thirdly, the findings are expected to offer guidance to educators and curriculum developers. If the design-based science activities are found to significantly improve

students' thinking skills, teachers may be encouraged to integrate more design-oriented projects and inquiry in their teaching, and curriculum developers might allocate more space for these approaches in educational programs. Ultimately, verifying the efficacy of DBR-based activities in improving critical and creative thinking can inform evidence-based decisions in teaching practice and educational policy.

In line with these aims, the research hypothesizes that students who participate in science activities developed through the design-based research method will show greater improvement in creative thinking (e.g., ability to generate original ideas, flexibility in thought) and critical thinking (e.g., ability to analyze information, evaluate arguments) compared to students experiencing traditional instruction. This expectation is supported by prior studies, which have demonstrated notable gains in creativity and critical reasoning following design-based interventions (Fortus et al., 2005; Raber, 2015; Ayyıldız & Yılmaz, 2021). By testing this hypothesis, the study will provide empirical evidence on the effectiveness of DBR-based pedagogy for skill development. The research will employ appropriate measures (such as creativity tests, critical thinking assessments, observational rubrics, etc.) to quantify changes in these skills, along with qualitative observations to understand how students engage with the design tasks. The mixed-method approach will enrich the findings, revealing not just if improvement occurs, but also how the design activities facilitate or hinder the thinking processes of students. In conclusion, this study is poised to offer meaningful contributions by evaluating a novel approach to science teaching in the context of cultivating crucial 21st-century skills. The insights gained are expected to advance the literature at the intersection of middle school science education and skill development, an area that stands to benefit from more research. If successful, the study will provide a model for integrating design-based research methods into regular classroom practice and demonstrate their value in enhancing student outcomes beyond content knowledge. Such evidence can inspire and inform educators, helping to shape science instruction that produces not only knowledgeable students but also innovative and critical thinkers prepared for the challenges of the future.

In this study, the following sub-problems were investigated:

- 1) Is there a significant difference between the pre-test and post-test results of the creative thinking tendencies of students in the control group?
- 2) Is there a significant difference between the pre-test and post-test results of the creative thinking tendencies of students in the experimental group?
- 3) Is there a significant difference between the pre-test results of the creative thinking tendencies of students in the experimental and control groups?
- 4) Is there a significant difference between the post-test results of the creative thinking tendencies of students in the experimental and control groups?
- 5) Is there a significant difference between the pre-test and post-test results of the critical thinking tendencies of students in the control group?
- 6) Is there a significant difference between the pre-test and post-test results of the critical thinking tendencies of students in the experimental group?
- 7) Is there a significant difference between the pre-test results of the critical thinking tendencies of students in the experimental and control groups?
- 8) Is there a significant difference between the post-test results of the critical thinking tendencies of students in the experimental and control groups?

METHOD

This study was conducted using a quasi-experimental design, one of the quantitative research methods. Specifically, a pretest-posttest control group design was employed (Büyüköztürk et al., 2016). In this study, the independent variable is the implementation of design-based science activities, while the dependent variables are students' creative thinking and critical thinking dispositions. The experimental group was exposed to design-based science activities, whereas the control group continued with the traditional science curriculum. Pretest and posttest measurements were conducted to compare changes in creative and critical thinking dispositions between the groups.

Study Group

The study group consisted of middle school students enrolled in a public school affiliated with the Ministry of National Education in Kastamonu, Türkiye. The random sampling method was used to select participants (Creswell & Poth, 2018), who were then assigned to experimental (n=40) and control (n=40) groups, resulting in a total sample size of 80 students. The following criteria were considered in selecting the sample:

- Students were in 7th grade.
- Their scientific process skills were at a comparable level.
- They had no prior experience with design-based learning models.

Participants were randomly assigned to experimental and control groups to ensure balance in terms of age, gender, and academic achievement.

Implementation Process

The research was conducted over a 6-week period within an educational program. Students in the experimental group participated in design-based science activities for two hours per week. These activities involved STEM-based design projects, problem-solving science tasks, and engineering applications requiring creativity. Table 1 presents the implementations conducted in the experimental and control groups.

Table 1. Implementation Process for Experimental and Control Groups

Week	Experimental Group (Design-Based Science Activities)	Control Group (Traditional Instruction)
1st Week	Introduction to scientific problem-solving and design thinking	Traditional science lessons
2nd Week	Simple engineering design: Bridge-building activity	Teacher-centered instruction
3rd Week	Experimental design activity on liquids and gases	Lecture-based teaching and Q&A
4th Week	Sustainability and ecosystem-based design project	Conventional classroom activities
5th Week	Scientific modeling and problem-solving STEM activities	Textbook and lesson materials
6th Week	Evaluation and presentation of all activities	In-class test and summary lessons

Before and after the implementation, the scales measuring critical and creative thinking dispositions were administered as pre-tests and post-tests to both the experimental and control groups, and the obtained data were compared. Figure 2 contains images related to the implementation process.



Figure 2. Images Related to the Implementation Process

Data Collection Instruments

Two different validated scales were used to collect data:

Marmara Critical Thinking Dispositions Scale (MCTDSa)

- Developed to measure students' critical thinking skills (Özgenel & Çetin, 2018).
- 5-point Likert-type scale with 6 sub-dimensions and 28 items.

Marmara Creative Thinking Dispositions Scale (MCTDSb)

- Developed to assess students' creative thinking tendencies (Özgenel & Çetin, 2017).
- 5-point Likert-type scale with 6 sub-dimensions and 25 items.

In this study, data were collected using two validated and reliable instruments: the Marmara Critical Thinking Dispositions Scale (MCTDSa) and the Marmara Creative Thinking Dispositions Scale (MCTDSb). The MCTDSa was developed by Özgenel and Çetin (2018). This scale consists of 28 items structured on a five-point Likert scale and encompasses six sub-dimensions: reasoning, reaching judgment, searching for evidence, searching for the truth, open-mindedness, and systematicity. The scale explains 56.35% of the total variance, and its overall internal consistency, as measured by Cronbach's alpha, is .91. The construct validity of the scale was established through exploratory and confirmatory factor analyses, while its reliability was further supported by test-retest procedures and comparisons between upper and lower 27% groups.

The Marmara Creative Thinking Dispositions Scale (MCTDSb), also developed by Özgenel and Çetin (2017), is another psychometrically sound instrument designed to assess general creative thinking dispositions. The scale comprises 25 items and six sub-dimensions: innovation search, courage, self-discipline, inquisitive, doubt, and flexibility. It is also based on a five-point Likert-type format. The scale accounts for 55.90% of the total variance and has a Cronbach's alpha coefficient of .87, indicating high internal consistency. Construct validity was confirmed via exploratory and confirmatory factor analyses, and test-retest reliability was supported by a significant correlation coefficient ($r = .88$; $p < .001$). This scale provides a reliable measure for assessing creative thinking dispositions.

These instruments were administered as both pretests and posttests, allowing for an analysis of changes in students' creative and critical thinking dispositions.

Data Analysis

In the analysis of the data obtained in this study, the first step was to examine whether the data followed a normal distribution. Normality tests indicated that the data were normally distributed. Accordingly, parametric tests were preferred to evaluate the effect of the experimental intervention. An independent samples t-test was conducted to determine the differences between the pre-test and post-test scores of the experimental and control groups. Additionally, Pearson correlation analysis was employed to examine the relationship between students' creative and critical thinking dispositions. All statistical analyses were performed using the SPSS software package, and the significance level was set at .05.

Validity and Reliability Studies

The validity and reliability of the data collection instruments used in the study were previously established by Özgenel and Çetin (2017; 2018). However, in this research, the researcher took several additional precautions to reinforce the validity and reliability of the data and ensure the accuracy of the results. First, a pilot study was conducted to confirm the appropriateness of the scales for the target population. The clarity of the items and the instructions was tested through feedback received from the participant group. Furthermore, prior to the administration of the instruments, students were provided with detailed explanations regarding how to complete the scales, and participation was based on informed consent in compliance with ethical principles.

FINDINGS

The first sub-problem of the research was stated as: *"Is there a significant difference between the pre-test and post-test results of the creative thinking tendencies of students in the control group?"* to address this question, an independent samples t-test was conducted, and the results for the control group are presented in Table 2.

Table 2. Pre-Test and Post-Test Results of the Control Group

Creative Thinking Tendencies	N	$\bar{X}$	SD	T	Df	p
Pre-Test	40	65.25	1.26	6.151	78	.001*
Post-Test	40	86.27	3.21			

* $p \leq .05$

When the pre-test and post-test results of the control group regarding creative thinking tendencies were examined, a statistically significant difference was found in favor of the post-test scores [$t_{(78)}=6.151$; $p=.001<.05$]. As shown in Table 2, the mean score of the control group increased from 65.25 (SD = 1.26) in the pre-test to 86.27 (SD = 3.21) in the post-test. This result indicates that even within the control group, which continued with traditional instruction, there was a significant improvement in students' creative thinking tendencies over the course of the study.

The second sub-problem of the research was stated as: *"Is there a significant difference between the pre-test and post-test results of the creative thinking tendencies of students in the experimental group?"* to address this question, an independent samples t-test was conducted, and the results for the experimental group are presented in Table 3.

Table 3. Pre-Test and Post-Test Results of the Experimental Group

Creative Thinking Tendencies	N	$\bar{X}$	SD	T	Df	p
Pre-Test	40	67.39	1.01	8.223	78	.000*
Post-Test	40	102.33	4.23			

*p≤ .05

When the pre-test and post-test results of the experimental group regarding creative thinking tendencies were examined, a statistically significant difference was found in favor of the post-test scores [$t_{(78)}=8.223$; $p=.000<.05$]. As seen in Table 3, the mean score of the experimental group increased substantially from 67.39 (SD = 1.01) in the pre-test to 102.33 (SD = 4.23) in the post-test. This result suggests that the design-based science activities implemented in the experimental group had a significant positive effect on enhancing students' creative thinking tendencies.

The third sub-problem of the research was stated as: *"Is there a significant difference between the pre-test results of the creative thinking tendencies of students in the experimental and control groups?"* to address this question, an independent samples t-test was conducted, and the results for the experimental and control group are presented in Table 4.

Table 4. Pre-Test Results of the Experimental and Control Groups

Creative Thinking Tendencies	N	$\bar{X}$	SD	T	Df	p
Experimental	40	67.39	1.01	-0.652	78	.062
Control	40	65.25	1.26			

*p≤ .05

When the pre-test scores of the experimental and control groups regarding creative thinking tendencies were compared, no statistically significant difference was found between the groups [$t_{(78)}=-0.652$; $p=.062>.05$]. As shown in Table 4, the experimental group had a mean score of 67.39 (SD = 1.01), while the control group had a mean score of 65.25 (SD = 1.26). These results indicate that both groups were at a comparable level in terms of creative thinking tendencies before the intervention, thus supporting the internal validity of the study by ensuring group equivalence at the baseline.

The fourth sub-problem of the research was stated as: *"Is there a significant difference between the post-test results of the creative thinking tendencies of students in the experimental and control groups?"* to address this question, an independent samples t-test was conducted, and the results for the experimental and control group are presented in Table 5.

Table 5. Post-Test Results of the Experimental and Control Groups

Creative Thinking Tendencies	N	$\bar{X}$	SD	T	Df	p
Experimental	40	102.33	4.23	4.546	78	.000*
Control	40	86.27	3.21			

*p≤ .05

When the post-test scores of the experimental and control groups regarding creative thinking tendencies were compared, a statistically significant difference was found between the groups [$t_{(78)}=4.546$; $p=.000<.05$]. As presented in Table 5, the experimental group had a post-test mean score of 102.33 (SD = 4.23), while the control group had a mean score of 86.27 (SD=3.21). This result indicates that the design-based science activities implemented in the experimental group significantly enhanced students' creative thinking tendencies compared to those in the control group.

The fifth sub-problem of the research was stated as: *"Is there a significant difference between the pre-test and post-test results of the critical thinking tendencies of students in the control group?"* to address this question, an independent samples t-test was conducted, and the results for the control group are presented in Table 6.

Table 6. Pre-Test and Post-Test Results of the Control Group

Critical Thinking Tendencies	N	$\bar{X}$	SD	T	Df	p
Pre-Test	40	77.23	2.01	5.185	78	.000*
Post-Test	40	109.23	4.01			

*p≤ .05

When the pre-test and post-test scores of the control group regarding critical thinking tendencies were compared, a statistically significant difference was found in favor of the post-test scores [$t_{(78)}=5.185$; $p=.000<.05$]. As shown in Table 6, the control group's

mean pre-test score was 77.23 (SD = 2.01), while the post-test mean increased to 109.23 (SD = 4.01). This result indicates that the traditional instructional process also contributed to a significant improvement in students' critical thinking tendencies.

The sixth sub-problem of the research was stated as: *"Is there a significant difference between the pre-test and post-test results of the critical thinking tendencies of students in the experimental group?"* to address this question, an independent samples t-test was conducted, and the results for the experimental group are presented in Table 7.

Table 7. Pre-Test and Post-Test Results of the Experimental Group

Critical Thinking Tendencies	N	$\bar{X}$	SD	T	Df	p
Pre-Test	40	79.22	2.02	4.937	78	.002*
Post-Test	40	122.53	3.71			

* $p \leq .05$

When the pre-test and post-test scores of the experimental group regarding critical thinking tendencies were compared, a statistically significant difference was found in favor of the post-test scores [$t_{(78)}=4.937$; $p=.002<.05$]. As presented in Table 7, the experimental group's mean pre-test score was 79.22 (SD = 2.02), while the post-test mean increased to 122.53 (SD = 3.71). This result indicates that the design-based science activities implemented in the experimental group significantly improved students' critical thinking tendencies.

The seventh sub-problem of the research was stated as: *"Is there a significant difference between the pre-test results of the critical thinking tendencies of students in the experimental and control groups?"* to address this question, an independent samples t-test was conducted, and the results for the experimental and control group are presented in Table 8.

Table 8. Pre-Test Results of the Experimental and Control Groups

Critical Thinking Tendencies	N	$\bar{X}$	SD	T	Df	p
Experimental	40	79.22	2.02	0.334	78	.096
Control	40	77.23	2.01			

* $p \leq .05$

When the pre-test scores of the experimental and control groups regarding critical thinking tendencies were compared, no statistically significant difference was found between the groups [$t_{(78)}=0.334$; $p=.096>.05$]. As shown in Table 8, the mean pre-test score of the experimental group was 79.22 (SD = 2.02), while that of the control group was 77.23 (SD = 2.01). This result indicates that both groups were at a similar level in terms of critical thinking tendencies prior to the intervention, supporting the equivalence of the groups at baseline.

The eighth sub-problem of the research was stated as: *"Is there a significant difference between the post-test results of the critical thinking tendencies of students in the experimental and control groups?"* to address this question, an independent samples t-test was conducted, and the results for the experimental and control group are presented in Table 9.

Table 9. Post-Test Results of the Experimental and Control Groups

Critical Thinking Tendencies	N	$\bar{X}$	SD	T	Df	p
Experimental	40	122.53	3.71	9.231	78	.000*
Control	40	109.23	4.01			

* $p \leq .05$

When the post-test scores of the experimental and control groups regarding critical thinking tendencies were compared, a statistically significant difference was found in favor of the experimental group [$t_{(78)}=9.231$; $p=.000<.05$]. As shown in Table 9, the experimental group's mean post-test score was 122.53 (SD = 3.71), while the control group's mean score was 109.23 (SD = 4.01). This result indicates that the design-based science activities implemented in the experimental group significantly enhanced students' critical thinking tendencies compared to those in the control group.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This study revealed that science activities designed through Design-Based Research (DBR) methodology significantly enhance middle school students' creative and critical thinking skills. The findings align with and confirm existing literature, underscoring the value of DBR-driven interventions in education (Azizan & Shamsi, 2022; Doppelt, 2006; Zhang et al., 2021).

For the first and second sub-problems, significant improvements were identified separately within both the control and experimental groups regarding students' creative thinking dispositions. However, the experimental group demonstrated a markedly higher increase, likely due to the problem-oriented nature of the design-based activities, which allowed students to actively engage with real-world problems. This aligns with the findings of Fortus et al. (2005), suggesting that DBR activities motivate students and increase their confidence in creative problem-solving. Furthermore, Geitz and de Geus (2019) emphasized

that the student-centered and inquiry-driven characteristics of DBR contribute directly to enhancing creativity, such as originality and flexibility. The third sub-problem indicated no significant difference between the experimental and control groups in their pre-test creative thinking scores, demonstrating initial equivalence between groups and strengthening the study's internal validity.

Regarding the fourth sub-problem, the post-test scores of the experimental group were significantly higher than those of the control group. This outcome strongly indicates that design-based science activities are more effective in promoting creative thinking skills than traditional instructional methods, a result consistent with prior research highlighting that design processes inherently foster innovative idea generation (Amabile & Pratt, 2016).

The fifth and sixth sub-problems revealed significant improvements in critical thinking dispositions in both the control and experimental groups separately. The improvement in critical thinking is attributable to the nature of the activities, requiring students to question, hypothesize, analyze data, and make evidence-based decisions. Similar findings have been consistently reported by Santos (2017) and Yacoubian (2015), reinforcing the role of analytical inquiry in promoting critical thinking development. The seventh sub-problem indicated no significant differences in critical thinking pre-test scores between experimental and control groups, confirming again the initial equivalence of the groups (Yılmaz, Uysal & Nacar, 2024).

The eighth sub-problem demonstrated a significant advantage for the experimental group's critical thinking post-test scores. DBR activities inherently facilitate critical reasoning through structured argumentation and iterative evaluation processes, which aligns with Baum-Combs, Cennamo, and Newbill's (2009) assertion that design-based learning environments nurture systematic critical thinking.

The outcomes of this study clearly demonstrate that science activities developed through Design-Based Research methodology significantly enhance middle school students' creative and critical thinking skills compared to traditional teaching methods. The practical and problem-centered nature of these activities effectively encouraged students to engage in authentic problem-solving tasks, stimulating their creativity and critical thinking. These findings, consistent with international literature (Azizan & Shamsi, 2022; Fortus et al., 2005; Zhang et al., 2021), validate the effectiveness of DBR methodologies in Turkish educational contexts. Consequently, it is recommended that educators and curriculum developers integrate DBR-driven activities to foster students' essential 21st-century cognitive skills.

Based on the findings of this research, the following recommendations are presented:

1. *Integration of DBR in Science Education:* Science curricula, particularly at the middle school level, should be enriched with design-based activities that explicitly aim to improve creative and critical thinking skills.
2. *Professional Development for Teachers:* Professional training programs should be provided to enable teachers to understand and effectively implement DBR methodologies in their classrooms, enhancing both their confidence and instructional skills.
3. *Broadening the Scope of Research:* This study was conducted in a single school in Kastamonu, Türkiye. Future studies should involve larger and more diverse samples from different geographic and socio-economic contexts to increase generalizability.
4. *Longitudinal Studies:* Further research should investigate the long-term impacts of DBR interventions on students' creative and critical thinking skills to determine sustained effectiveness over extended periods.
5. *Interdisciplinary Applications:* Research should also focus on integrating design-based learning activities with other disciplines such as mathematics, technology, or engineering to investigate the effects of interdisciplinary education on cognitive skill development.
6. *Qualitative Investigations:* Future studies should incorporate qualitative research methodologies, including student interviews and classroom observations, to gain deeper insights into how students perceive and experience the learning processes inherent in design-based activities.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author received no financial support for the research, author-ship, and/or publication of this article.

Statements of publication ethics

I hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

In this research, all processes were carried out by the author himself.

REFERENCES

- Aguilera-Hermida, A. P. (2020). College students' use and acceptance of emergency online learning due to COVID-19. *International Journal of Educational Research Open*, 1, 1-8. <https://doi.org/10.1016/j.ijedro.2020.100011>
- Amabile, T.M., Pratt, M.G. (2016). The dynamic componential model of creativity and innovation in organizations: Making progress, making meaning. *Research in Organizational Behavior*, 36, 157–183. <https://doi.org/10.1016/j.riob.2016.10.001>
- Ayyıldız, P., & Yılmaz, A. (2021). 'Moving the kaleidoscope' to see the effect of creative personality traits on creative thinking dispositions of pre-service teachers: The mediating effect of creative learning environments and teachers' creativity fostering behavior. *Thinking Skills and Creativity*, 41, 100879, 1-10. <https://doi.org/10.1016/j.tsc.2021.100879>
- Ayyıldız, P., & Yılmaz, A. (2023). A New Chapter is Being Written About Writing Instruction: Instructional Leadership at K-12 Levels in The Age of Artificial Intelligence (AI). *Educational Policy Analysis and Strategic Research*, 18(4), 82-101. <https://doi.org/10.29329/epasr.2023.631.4>
- Azizan, S.A., & Shamsi, A.N. (2022). Design-based learning as a pedagogical approach in an online learning environment for science undergraduate students. *Frontiers in Education*, 7, 1-7. <https://doi.org/10.3389/feduc.2022.860097>
- Barab, S., & Squire, K. (2004). Design-based research: Putting a stake in the ground. *Journal of the Learning Sciences*, 13(1), 1-14.
- Baron, C., & Daniel-Allegro, B. (2019). About adopting a systemic approach to design connected embedded systems: a MOOC promoting systems thinking and systems engineering. *Systems Engineering*, 23, 261–280. <https://doi.org/10.1002/sys.21513>
- Baum-Combs, L., Cennamo, K.S., & Newbill, P.L. (2009). Developing critical and creative thinkers: Toward a conceptual model of creative and critical thinking processes. *Educational Technology*, 49(5), 3-14.
- Büyüköztürk, Ş., Kılıç, E., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2016). *Bilimsel araştırma yöntemleri*. Ankara: Pegem Yayınları.
- Bybee, R. 2010. *The teaching of science: 21st-century perspectives*. Arlington, VA: NSTA Press.
- Collins, A. (1992). Toward a design science of education. In E. Scanlon & T. O'Shea (Eds.), *New directions in educational technology* (pp. 15–22). New York: Springer-Verlag.
- Creswell, J.W., & Poth, C.N. (2018) *Qualitative inquiry and research design choosing among five approaches*. 4th Edition, SAGE Publications, Inc., Thousand Oaks.
- Design-Based Research Collective. (2003). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher*, 32(1), 5–8, 35–37. <http://www.designbasedresearch.org/reppubs/DBRC2003.pdf>
- Doppelt, Y. (2006). Teachers' and pupils' perceptions of science–technology learning environments. *Learning Environments Research*, 9(2), 163–178.
- Ennis, R. H. (1991). Critical thinking: A streamlined conception. *Teaching Philosophy*, 14(1), 5–24.
- Facione, P. A. (1990). Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction. *American Philosophical Association Delphi Report*.
- Fortus, D., Krajcik, J., Dersheimer, R. C., Marx, R. W., & Mamlok-Naaman, R. (2005). Design-based science and real-world problem-solving. *International Journal of Science Education*, 27, 855–879. <http://dx.doi.org/10.1080/09500690500038165>
- Geitz, G., & de Geus, J.D. (2019). Design-based education, sustainable teaching, and learning. *Cogent Education*, 6, 1–14. <https://doi.org/10.1080/2331186X.2019.1647919>
- Hacıoğlu, Y., & Kutru, Ç. (2021). Fen eğitimiyle yaratıcı düşünme becerisinin geliştirilmesi: Türkiye’de yürütülen lisansüstü tezlerden yansılar. *Anadolu Öğretmen Dergisi*, 5(1), 77-96. <https://doi.org/10.35346/aod.937208>
- Halpern, D. F. (2013). *Thought and knowledge: An introduction to critical thinking* (5th ed.). New York: Psychology Press.
- Ministry of National Education (MoNE) (2018). *Fen Bilimleri Dersi Öğretim Programı (İlkokul ve Ortaokul 3, 4, 5, 6, 7 ve 8. Sınıflar)*. Ankara: Milli Eğitim Bakanlığı.
- Mumford, M.D. (2003). Where have we been, where are we going? Taking stock in creativity research. *Creativity Research Journal*, 15(2–3), 107-120. <https://doi.org/10.1080/10400419.2003.9651403>
- National Research Council (NRC) (2010). *Exploring the intersection of science education and 21st century skills: A workshop summary*. National Academies Press.
- National Science Teaching Association (NSTA) (2013). *Next generation science standards for today's students and tomorrow's workforce*. National Academies Press.
- Organisation for Economic Co-Operation and Development (OECD) (2018). *The future of education and skills: Education 2030*. OECD Publishing.
- Özgenel, M., & Çetin, M. (2017). Marmara yaratıcı düşünme eğilimleri ölçeğinin geliştirilmesi: Geçerlik ve güvenirlik çalışması. *Marmara Üniversitesi Atatürk Eğitim Fakültesi Eğitim Bilimleri Dergisi*, 46(46), 113-132. <http://dx.doi.org/10.15285/maruaebd.335087>

- Özgenel, M., & Çetin, M. (2018). Development of the Marmara Critical Thinking Dispositions Scale: Validity and reliability analysis. *International Journal of Eurasia Social Sciences*, 9(32), 991-1015.
- Partnership for 21st Century Skills (P21) (2009). *Framework for 21st Century Learning*. https://www.marietta.edu/sites/default/files/documents/21st_century_skills_standards_book_2.pdf
- Raber, C. (2015). *Design based learning for elementary school classroom: Critical and process document*. Vancouver, BC: Emily Carr University.
- Sandoval, W. (2014). Conjecture mapping: An approach to systematic educational design research. *Journal of the Learning Sciences*, 23(1), 18–36.
- Santos, L.F. (2017). The role of critical thinking in science education. *Journal of Education and Practice*, 8(20), 159-173.
- Sternberg, R.J., Sternberg, K. (2011). *Creativity. Cognitive Psychology (6 ed.)*. Cengage Learning. (pp. 479–483).
- Torrance, E. P. (1966). *The Torrance tests of creative thinking*. scholastic testing service.
- Trilling, B., & Fadel, C. (2009). *21st century skills: Learning for life in our times*. Jossey-Bass.
- URL-1 (2025). *Critical and Creative Thinking by Design. (IDEA Studio)*. VirginiaTech-Institute for Creativity, Arts, and Technology. 11.03.2025. <https://vtechworks.lib.vt.edu/server/api/core/bitstreams/0848f1da-c7e5-4f14-885b-b1719e3b4a89/content#:~:text=Baum,About%20Us>
- Vattam, S., & Kolodner, J.L. (2006). Design-based science learning: important challenges and how technology can make a difference,” in *Proceedings of the International Conference of the Learning Sciences*, (Bloomington, Indiana: Lawrence Erlbaum Associates, Inc.). 799–805.
- Wang, F., & Hannafin, M.J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development*, 53(4), 5-23.
- Yacoubian, H. A. (2015). A framework for guiding future citizens to think critically about nature of science and socioscientific issues. *Canadian Journal of Science, Mathematics and Technology Education*, 15(3), 248-260.
- Yılmaz, A. (2021). The effect of technology integration in education on prospective teachers' critical and creative thinking, multidimensional 21st century skills and academic achievements. *Participatory Educational Research*, 8(2), 163-199. <https://doi.org/10.17275/per.21.35.8.2>
- Yılmaz, A., Uysal, G., & Nacar, M. (2024). *Düşünme becerilerine (yaratıcı, yansıtıcı, eleştirel ve problem çözme) bakış*. M. Korucuk (Ed.). *Eğitimin Temellerine Bakış: Program Geliştirme-Yeni Yaklaşımlar içinde* (ss.165-180). İstanbul: Efe Akademi Yayıncılık.
- Zhang, H., Zhao, Y., & Barab, S. (2021). Analyzing the impact of design-based learning on students' problem-solving and critical thinking skills. *International Journal of Science Education*, 43(9), 1235-1252.



| Research Article / Araştırma Makalesi |

Common Knowledge Construction Model Applications: Investigating the Effects on Academic Achievement and Retention¹

Ortak Bilgi İnşa Modeli Uygulamaları: Akademik Başarı ve Kalıcılık Üzerindeki Etkilerin İncelenmesi

Ozan Emre DEMİREL², Lütfullah TÜRKMEN³

Keywords

- 1.Argumentation-based learning
- 2.Common knowledge construction model
- 3.PECED papers
- 4.Socioscientific issues
- 5.Three-stage achievement test

Anahtar Kelimeler

- 1.Argümantasyona dayalı öğrenme
- 2.Ortak bilgi inşa modeli
- 3.TAVAÇ kağıtları
- 4.Sosyobilimsel konular
- 5.Üç aşamalı başarı testi

Received/Başvuru Tarihi
05.06.2024

Accepted / Kabul Tarihi
25.07.2025

Abstract

This research investigates the effects of the Common Knowledge Construction Model (CKCM) applied to the 6th-grade "matter and heat" unit of the Science Curriculum on students' academic achievements retention. The study employed "pre-test post-test non-equivalent control group design" was adopted. The research was conducted during the 2018-2019 academic year and lasted for 9 weeks, involving a total of 72 students from a middle school located in a province in the Aegean region in Turkey. Data collection instrument was developed by the researchers. Matter and Heat academic achievement test was applied to the groups as pre-test, post-test and retention test. From the results it was determined that lessons taught according to CKCM were more effective in improving students' academic achievements and retentions compared to the instructional practices included in the Science Curriculum.

Öz

Bu araştırmada, 6. sınıf fen bilimleri dersi "madde ve ısı" ünitesine yönelik uygulanan Ortak Bilgi İnşa Modeli'nin (OBİM) öğrencilerin akademik başarıları ve bilgilerinin kalıcılığı üzerindeki etkileri incelenmiştir. Çalışmada "ön test son test eşitlenmemiş kontrol gruplu araştırma deseni" kullanılmıştır. Araştırma 2018-2019 eğitim öğretim yılında yürütülmüş ve 9 hafta sürmüş olup çalışmaya Türkiye'nin Ege Bölgesi'ndeki bir ilde bulunan bir ortaokuldan toplam 72 öğrenci katılmıştır. Veri toplama aracı araştırmacılar tarafından geliştirilmiştir. Madde ve Isı akademik başarı testi gruplara ön test, son test ve kalıcılık testi olarak uygulanmıştır. Çalışmadan elde edilen sonuçlardan, OBİM'e göre işlenen derslerin, Fen Bilimleri Dersi Öğretim Programı'nda yer alan öğretim uygulamalarına kıyasla öğrencilerin akademik başarılarını ve bilgilerinin kalıcılıklarını arttırmada daha etkili olduğu belirlenmiştir.

¹This research was produced from the doctoral thesis prepared by the first author under the supervision of the second author.

²Corresponded Author, Uludag University, Inegöl vocational school, Bursa, Türkiye; <https://orcid.org/0000-0003-4594-055X>

³Uşak University, Faculty of Education, Department of Mathematics and Science Education, Uşak, Türkiye; <https://orcid.org/0000-0002-6022-0633>

INTRODUCTION

Situations such as keeping up with the constantly changing era and searching for solutions to global problems increase the importance of science and technology every day (Demirel, 2024a). The science course is an important resource for the development of these situations. Because science studies the phenomena in nature and tries to discover the laws and principles underlying these phenomena (Demirel & Türkmen, 2023). In addition, there are many alternative ways that provide the student with opportunities to understand and apply scientific methods in the science course. This situation allows students to become more effective thinkers (Bozkurt, Ay & Fansa, 2013). The more skills a student uses in classes, the greater the retention of knowledge. Thanks to the permanent accumulation of knowledge, students become academically successful, productive and more active (Tuysuz & Demirel, 2020). Therefore, science educators have been developing approaches and models that enable students to establish connections with real-life and acquire useful knowledge (Bakırcı & Çepni, 2012; Demirel, 2024b). The Science Curriculum implemented in 2018 is based on the research and inquiry-based learning approach (MEB, 2018). According to the research and inquiry-based learning approach, the majority of responsibility, from investigating a problem to finding a solution, lies with the students.

CKCM is a model that integrates four different perspectives: student, teacher, learning environment, and curriculum (Biernacka, 2006). In this model, a learning environment is created where scientific discourse takes place to facilitate conceptual changes and the attainment of shared knowledge as a class. In these environments, students' ideas are brought to the surface. Furthermore, students are allowed to generate arguments and express and evaluate them explicitly. At the end of the instruction, a consensus is reached on a set of views, and the construction of shared knowledge is achieved (Ebenezer & Fraser, 2001). The first stage of CKCM involves argumentation-based learning, where students explain their thoughts with various justifications and support them with different claims. Another stage focuses on the nature of science. In yet another stage, socioscientific issues are thoroughly discussed. During these discussions, students express their opinions along with their justifications. Consequently, students propose solutions to social and environmental problems at the local or national level (Ebenezer et al., 2010). CKCM is a learning model that enables students to establish connections both with their own lives and with real-life situations. In this model, students reconstruct their personal ideas by utilizing their prior knowledge. As a result, they become aware of their ability to access knowledge through exploration, research, and inquiry (Ebenezer et al., 2010). In this context, it can be said that CKCM aligns with the structure of the 2018 Science Curriculum.

CKCM emphasizes that knowledge is not only acquired through experiments, observations, or proofs, but also through social dimensions such as discussions, sharing, and negotiations (Ebenezer & Connor, 1999). Therefore, in order to interpret the views that emerge at the end of students' personal interactions with the natural environment and their social interactions with others, it is important to first determine students' perspectives on the world and establish a strong connection between personal views and scientific views (Ebenezer & Fraser, 2001). To establish this connection, classroom environments that utilize scientific language should be created. In such environments, student perspectives and scientific views converge through argumentation (scientific discussions). At the end of the process, shared knowledge is formed. Scientific discussions should be based on evidence, justifications, and inferences. Students search for evidence to either accept their own views or refute others' views during these discussions, and they obtain this evidence through experiments and research. Throughout the process of communicating with each other, they use scientific language and engage in social negotiations to reach shared knowledge (Ebenezer & Fraser, 2001). The CKCM does not focus on fitting students' thoughts about an event or concept into specific patterns or changing their beliefs. Instead, it aims to generate diverse thoughts of different qualities and focuses on constructing meanings solely related to the topic, concept, or phenomenon (Ebenezer et al., 2010).

CKCM consists of four interconnected stages: "Exploring and Categorizing," "Discussing and Constructing," "Expanding and Applying," and "Reflecting and Evaluating" (Ebenezer et al., 2010). In this model, throughout the stages, each student becomes aware of their own and their peers' conceptual understandings. Therefore, CKCM is a learning model based on cognitive awareness (Kaya, 2014).

Exploring and Categorizing Stage

In this stage, the influences of students' attitudes towards a natural or social phenomenon are revealed (Biernacka, 2006). For this purpose, students are presented with a concrete science event from their own lives, which they are very familiar with (Kaya, 2014). The aim here is to determine the students' readiness levels regarding the topic and to motivate their engagement. Additionally, attention is drawn to the topic and students are made aware of the nature of science (Bakırcı & Çepni, 2012). To achieve this, activities such as demonstrations, videos, pictures, activities, brainstorming, which reveal the relationships between natural events and students' thoughts in their minds, are included in this stage. Through these activities, students acquire knowledge about the nature of science, and alternative concepts and misconceptions related to the topic are identified (Bakırcı & Çepni, 2014). Furthermore, in this stage, students' ideas are not expressed as right or wrong with definitive judgments. Students share their personal ideas with the class, fostering a process of negotiation and idea sharing among students. Therefore, multiple ideas related to the topic are encouraged in this stage (Ebenezer et al., 2010). At the beginning of the process, students experience curiosity and exploration. By the end of the process, students realize that their own knowledge or scientific knowledge can change, that it is flexible in nature, and that science is a discipline that investigates and explains phenomena in nature (Biernacka, 2006).

The teacher, in this stage, carefully listens to and interprets the ideas that students acquire through their experiences and creates phenomenographic categories related to the topic. The teacher also takes on a supportive role by creating an environment where students can express their ideas openly (Biernacka, 2006). Another task of the teacher in this stage is to make students feel like scientists as they approach a laboratory or encounter a natural event (Kaya, 2014). For this purpose, teachers use strategies such as concept maps, class discussions, semi-structured interviews, journals, PEOE (Prediction, Explanation, Observation, Explanation), written or illustrated response questions, brainstorming, portfolios (Çavuş-Güngören, 2015).

In this study, PECED (Predict, Explain, Collect Data, Explain, Draw) paper activities were used in the exploring and categorizing stage of CKCM. These activities were developed by the researcher based on the PECED papers developed by Kaya (2016).

Constructing and Negotiating Stage

In this stage, conducted according to argumentation-based learning, the categories obtained based on phenomena are discussed as competing theories by thought groups consisting of 3-4 individuals (Kaya, 2014). During these discussions, students explain the categories they have chosen through various justifications using arguments. Student groups opposing the views or supporting other categories develop counter arguments. Throughout the process, each category is thoroughly tested by student groups. After each category is addressed, attempts are made to reach common conclusions from the obtained perspectives. The results are determined through teacher-student collaboration. In the final part of this stage, students are asked to make drawings on PECED papers. Later, student drawings made on PECED papers during the first stage are compared with the drawings obtained from this stage. Through the differences between the drawings, students have the opportunity to evaluate both themselves and their peers (Kaya, 2014). Since students construct meaning through discussions with their peers and teachers, knowledge is socially constructed in this process (Duschl & Osborne, 2002). In this stage, while developing social skills such as understanding the thoughts of others and empathizing with them (Biernacka, 2006), students also become aware that their existing concepts can change through processes such as research, critical thinking, and peer sharing (Ebenezer & Connor, 1999). Another important aspect in this stage is that students can use their creativity and imagination (Bakırcı & Çepni, 2014).

In this stage, students also learn what scientific research studies entail. In other words, just as a scientist shares their ideas, thoughts, and results with other scientists in different locations during their research studies, students also share their own ideas and results with their peers (Kaya, 2014; Tuysuz, Demirel & Yildirim, 2013; Demirel, 2014). In this stage, students also realize that scientists are individuals open to criticism, and they gain the idea that their own ideas may be similar to the thoughts of past scientists (Kaya, 2014; Tuysuz, Yildirim & Demirel, 2014). The transfer of the historical development of science to educational environments also takes place in this stage (Ebenezer & Connor, 1999). Additionally, the awareness that many scientists in different countries contribute to the development of science and face certain challenges in accessing shared knowledge also occurs in this stage (Ebenezer & Puvirajah, 2005).

The teacher's role in this stage is to guide the process and mediate among students (Ebenezer & Connor, 1999). The teacher does not construct the knowledge obtained by students. On the contrary, they assist in students' mental development and maintain constant communication with students throughout the lesson. In doing so, the teacher discovers students' learning needs, interests, and abilities (Wood, 2012). While conducting assessments throughout the process, the teacher also assists students in maximizing their performance (Demirel, 2022).

Extending and Translating Stage

In this stage, a video, slideshow, or visual materials related to a socio-scientific topic of the lesson are presented to the class using tools such as interactive whiteboards, projectors, computers, etc., in a way that all students can see and hear comfortably. Socio-scientific topics refer to subjects concerning society that do not have definite answers or absolute truths, such as economics, health, politics, etc. (Pedretti, 1999; Sadler, 2004). Genetic cloning, euthanasia, air pollution, global warming, energy conservation, nuclear power plants, thermal power plants, and hydroelectric power plants are some examples of socio-scientific topics. Socio-scientific topics enable students to critically examine events and develop thinking skills based on scientific evidence (Walker & Zeidler, 2007). These topics often involve open-ended and complex issues, encompassing both scientific and social aspects simultaneously (Sadler, 2004). These discussion-provoking socio-scientific topics closely relate to science and have implications for people, which can lead to opposing opinions and disagreements within society (Topçu, 2015). For example, while one group of people may view thermal power plants as a threat to nature, another group may support their establishment due to the job opportunities they provide. This perspective can be economically driven, as countries may consider it a means of generating income.

In the first two stages of CKCM, students gain the opportunity to discuss socio-scientific topics and conceptualize scientific thinking based on the knowledge they have acquired (Ebenezer et al., 2010). Additionally, students can relate the newly learned information to situations they encounter in daily life and transfer their constructed views to other social issues, in other words, expand their understanding (Ebenezer & Connor, 1999). Another important aspect of the third stage of CKCM is that students are asked to design products. For this purpose, students are assigned mini-projects such as participating in a survey, interviewing experts, preparing posters or newspaper articles. The determination of these mini-project topics is done under the guidance of the teacher within the classroom. Students work in small groups together with their peers during this process. Therefore, while a part of the product design process takes place in the classroom, another part occurs in out-of-school learning environments. The

groups then present their projects at an appropriate time in a different lesson. After the presentations, efforts are made to reach a common decision through argumentation (Kaya, 2014).

Reflecting and Assessing Stage

While this stage is theoretically included in CKCM, in practice, it is carried out simultaneously with the first three stages (Kaya, 2014). In other words, reflection and evaluation are conducted throughout all stages of CKCM during the learning process. In this process, the determination of whether students have learned the subject or not is achieved through alternative assessment techniques. Traditional assessment methods make it more difficult to determine whether students' misconceptions have changed, how they have learned rather than what they have learned, and whether discovery and mental structuring have occurred (Bakirci and Çepni, 2012).

Moreover, the reflection and evaluation stage also provide an opportunity for teachers to develop classroom practices and gather regular information about students. Through this, teachers can assess students' behaviors, attitudes, scientific research skills, and social skills. In the first stage of CKCM, attempts are made to determine the prior knowledge students bring to the class. For this purpose, concept maps, semi-structured interviews, student journals, diagrams, etc., can be used (Ebenezer & Connor, 1999). In this research, in the first stage of CKCM, students' prediction, inference, observation, data collection, making explanations, and drawing skills were measured. For this purpose, PECED papers were distributed to the students. Additionally, students were asked to keep a journal at the end of each lesson to reveal their own thoughts.

In the second stage of CKCM, attempts are made to determine whether students participate in the argumentation process, whether they can form arguments, whether they can convince their peers in the opposing group using justifications, and whether they can reach common knowledge at the end of the study. In this stage, students' scientific research skills and collaboration skills are also evaluated. In the third stage, it is aimed to determine whether students can combine the knowledge they have learned with daily life and technology and whether they can discuss socioscientific issues (Biernacka, 2006). In the fourth stage, descriptions and drawings in PECED papers, mini-projects designed by students, and the presentation of these projects in the classroom can be used to make assessments regarding students' learning levels (Kaya, 2014). When we look at the research on CKCM, it is observed that studies conducted abroad stand out initially. Ebenezer and Connor (1999) introduced the philosophy, basis, and rationale of CKCM, which is a new learning model. This research demonstrated that the model is suitable for science teaching. In another study conducted by Ebenezer et al. (2004), the teacher activity in lessons taught according to CKCM was investigated, and it was revealed that the model requires extensive preparation, is time-consuming, and difficult to implement in crowded classrooms. Biernacka (2006) demonstrated the positive impact of CKCM on fifth-grade students' scientific literacy, while Ebenezer et al. (2010) showed its positive effects on conceptual change and science achievement in seventh-grade students. Wood et al. (2013) and Wood (2012) reported that the model positively contributes to the academic achievement and conceptual changes of high school students. In terms of domestic studies, Çalık and Cobern (2017) investigated the effects of CKCM on the conceptual understanding, attitudes, and scientific habits of teacher candidates in Turkey and the United States, and statistically significant differences were found in favor of Turkish teacher candidates.

When reviewing the literature, it can be seen that studies related to CKCM are limited and primarily focus on determining the theoretical content, classroom applications, conceptual change, attitudes, scientific habits, scientific literacy, and its effects on academic achievement. The research mainly focuses on university students, middle school students, and teachers. This research, however, is important in terms of examining the impact of CKCM-based science instruction on academic achievement in the context of primary school students and questioning its feasibility in the science curriculum by presenting student perspectives. By focusing on classroom implementation of the method, it is expected to fill a gap in the literature in terms of providing researchers with an example application in the country.

The aim of this study is to investigate the effects of CKCM-based science teaching, implemented in accordance with the 2018 Science Curriculum, on academic achievement in the "matter and heat" unit of the 6th-grade science course, and to reveal student perspectives on CKCM practices by comparing them with the existing method.

Research Questions:

1. Does the implementation of the 6th-grade science course unit "Matter and Heat," based on the Shared Knowledge Construction Model and the 2018 Science Curriculum, have an impact on students' academic achievement?
2. Does the implementation of the 6th-grade science course unit "Matter and Heat," based on the Shared Knowledge Construction Model and the 2018 Science Curriculum, have a long-term impact on students' academic achievement?

METHOD

Research Design

In this study, the quantitative phase employs a quasi-experimental design was used which known as the "pre-test post-test non-equivalent control group design" to determine the effectiveness of two different instructional methods: CKCM and the existing science teaching program (Creswell, 2003). The pre-test post-test non-equivalent control group design is used when it is difficult to achieve random assignment of groups in educational research (Karasar, 2010). The implementation process in the experimental and control groups is presented in Table 1.

Table 1. Implementation Process in Experimental and Control Groups.

Group	Pre-Test	Process	Post Test	Retention Test
Experimental Group	MHAT	CKCM, PECED Papers	MHAT	MHAT
Control Group	MHAT	2018 Science Curriculum	MHAT	MHAT

Table 1 shows that prior to the implementation of the interventions, a pre-test called the "Matter and Heat Achievement Test (MHAT)" was administered to the experimental and control groups to check for any pre-existing differences that could potentially affect the study. At the end of the interventions, the same test administered as the pre-test was conducted as a post-test to the same groups. Additionally, this test was administered as a follow-up test to the experimental and control group students in the next semester. These tests aimed to determine the academic achievements of students in the 6th-grade science unit "Matter and Heat." In the study, PECED papers (Appendix 1.) were administered to the experimental group students, while they were not administered to the control group students. In addition to the experimental and control groups, one class was designated as a pilot class. The reason for selecting a pilot class was to allow the researcher to gain experience in conducting the study in the experimental group. Moreover, the suitability of the stories and sample cases in the PECED papers to students' prior knowledge, the comprehensibility of the upcoming experiments, educational games, and activities by the students, and the necessary modifications in non-functional PECED papers were intended to be determined."

Population and Sampling

The study group of this research consists of a total of 72 sixth-grade students from a middle school in the Aegean Region, Turkey. Random assignment was used to determine the experimental and control groups.

Data Collection Tool

Matter and Heat Achievement Test (MHAT)

The MHAT was used to collect quantitative data in this study. A three-stage MHAT developed by the researchers was used. Twenty-one questions were prepared to measure the 14 achievements specified in the 2018 Science Curriculum. The first stage of the test included multiple-choice questions, while the second stage included multiple-choice options with different alternatives related to the choices in the first stage. In the third stage of the test, students were asked to write down the reasons for their chosen options in their own sentences. In the literature, the third stage of three-stage achievement tests usually asks students if they are confident in their chosen options. However, in this developed achievement test, students were required to provide detailed explanations for the choices they made in the first two stages during the third stage. The aim here was to minimize the chance factor during the measurement of students' acquired knowledge. For any given question in the developed achievement test to be considered correct, students needed to have chosen the correct options in the first two stages and provide accurate explanations in the third stage. Questions were not considered correct for those who only marked one option correctly or only provided the correct justification.

Validity and Reliability Analysis of the MHAT

Data used for calculating the validity analysis of the scale were obtained from a total of 72 students in three groups (Experimental Group, Control Group, and Pilot Group). To determine the content validity of the developed Matter and Heat Achievement Test, expert opinions were obtained from three faculty members specializing in science education and two science teachers. According to the expert opinions, the content validity of the test was found to be high. Additionally, the test was reviewed by one Turkish language teacher to assess its grammatical aspects. The internal consistency reliability of the test was found to be 0.78 based on the KR-20 coefficient. A reliability coefficient of 0.70 or higher is generally considered sufficient for the reliability of test scores (Büyüköztürk, 2004).

The item discrimination index, denoted as "r_j," indicates the degree to which the items in a test differentiate between those who know and those who do not. The item discrimination index ranges from -1 to +1. As it approaches +1, the discrimination increases, while it decreases as it approaches 0 and -1. Items with a positive discrimination index are considered for inclusion in the test if their item discrimination index is between 0.30 and 0.40. If the index is 0.40 or higher, it is an ideal item for the test. All items with values below 0.30 are removed from the test (Ebel, 1965). The table below shows the item discrimination index (r_{jx}) values for the 21 items in the Matter and Heat Achievement Test.

Table 2. Discrimination Index (r_{jx}) Values of the Items in the MHAT

Item	(r _{jx})	Item	(r _{jx})	Item	(r _{jx})	Item	(r _{jx})
1	0,31	7	0,50	13	0,11	19	0,47
2	0,49	8	0,54	14	0,55	20	0,52
3	0,55	9	0,56	15	0,57	21	0,54
4	0,24	10	0,53	16	0,39		
5	0,36	11	0,51	17	0,45		
6	0,43	12	0,56	18	0,48		

When looking at Table 2, it can be seen that items 4 and 13 have discrimination indices below 0.30 (0.24 and 0.11), so they were removed from the test. The remaining 19 items have a total discrimination index of R_j (avg) = 0.49. Since this value is above 0.40, it can be said that the overall discrimination of the test is good.

The item difficulty index represents the percentage of individuals who answered an item correctly and is denoted as P. If all 100 individuals in the test answer an item correctly, the P value is 1, indicating an extremely easy item. If no one answers an item correctly, the P value is 0, indicating an extremely difficult item. Additionally, if the P value is between 0.80 and 1.00, it is a very easy item. If the P value is between 0.60 and 0.79, it is an easy item. If the P value is between 0.40 and 0.59, it is a moderately difficult item. If the P value is between 0.20 and 0.39, it is a difficult item. And if the P value is between 0.00 and 0.19, it is a very difficult item (Tekin, 2000). Table 3 presents the item difficulty index (Pjx) values and item difficulty levels for the 21 items in the MHAT.

Table 3. Item Difficulty Index (Pjx) Values of the Items in the MHAT

Item	(Pjx)	Item Difficulty Level	Item	(Pjx)	Item Difficulty Level	Item	(Pjx)	Item Difficulty Level
1	0,81	Very easy	8	0,25	Difficult	15	0,58	Middle
2	0,43	Middle	9	0,47	Middle	16	0,87	Very easy
3	0,46	Middle	10	0,16	Very difficult	17	0,45	Middle
4	0,83	Very easy	11	0,82	Very easy	18	0,47	Middle
5	0,14	Very difficult	12	0,69	Easy	19	0,66	Easy
6	0,41	Middle	13	0,80	Very easy	20	0,55	Middle
7	0,56	Middle	14	0,64	Easy	21	0,16	Very difficult

As seen in Table 3, the test includes 9 items at the 'Moderate' difficulty level and 5 items at the 'Very Easy' level. Due to the low discrimination of items 4 and 13, which were removed from the test, the number of items at the 'Very Easy' level decreased to 3. Furthermore, the table shows that there are 3 items each at the 'Easy' and 'Very Difficult' levels, while the number of items at the 'Difficult' level is 1. After removing items 4 and 13 from the test, the item difficulty index ($P_j(\text{avg})$) for the remaining items was calculated as 0.54. Since this value falls between 0.40 and 0.59, we can say that the Matter and Heat Achievement Test has a moderate level of difficulty.

Based on all the data obtained from the analyses, it can be concluded that the Matter and Heat Achievement Test has high validity, reliability, good discrimination, and a moderate level of difficulty. The test was initially administered as a pre-test to determine whether there was a significant difference in the students' achievements in the 'Matter and Heat' unit of the science course before implementing the 'Matter and Heat Achievement Test.' After the study, it was administered as a post-test to determine whether there was a significant difference in student achievements depending on the applied methods. Additionally, this test was also administered as a follow-up test in the subsequent period for the experimental and control groups.

Application Process

The research was conducted in the academic year 2018-2019 in a middle school affiliated with the Ministry of National Education (in Turkish MEB) in Aegean Region, Turkey. All studies in the experimental and control groups were carried out by researchers who were experts in the field of the common knowledge construction model and who had not met the students before. The study consisted of 1 experimental group, 1 control group, and 1 pilot group. A total of 72 sixth-grade students, with 24 students from each group, participated in the research. While the CKCM was implemented in the experimental group, the subjects were taught according to the 2018 Science Curriculum in the control group. In the pilot group, the subjects were taught based on the CKCM, which was also applied in the experimental group. The applications in the experimental and control groups started and ended in the same week. However, the activities in the pilot group started 2 weeks earlier and ended 2 weeks earlier compared to the experimental and control groups.

Additionally, in one class hour of the following week, all students in the experimental and control groups were informed about the methods to be applied and the materials to be used in the study. In the second lesson of the same week, the "Matter and Heat Achievement Test" was applied as a pre-test under exam conditions in order to measure the prior knowledge and skills of the students in the groups. The applications were then carried out in the subsequent weeks. The applications in the experimental, control, and pilot groups, excluding the pre-test and post-test lasted a total of 28 class hours (7 weeks). The applications included PECED paper activities, socioscientific issues, and mini-projects developed by the students, while the materials specified in the 2018 Science Curriculum were used in the control group.

Application Process in the Experimental Group

In the class assigned as the experimental group, the lessons were taught according to the CKCM. Throughout the application, PECED papers prepared for the achievements in the "Matter and Heat" unit were distributed to the students. The students started their work by examining the story or sample case presented on these papers. They also recorded the data they obtained during the study on these papers. To allow extensive discussions among students during argumentation practices, a suitable environment was created in the classroom. Each argument formed based on the compilation of student predictions was developed through their collective thoughts. During the processing of socioscientific issues included in the study, the researcher utilized the smart

board and computer available in the classroom. Additionally, all students were asked to keep a journal throughout the study, documenting what they learned each day.

The application of the CKCM began with the "Exploration and Categorization" phase, using PECED paper activities. After examining the sample case or story presented on the PECED paper, the researcher introduced the daily phenomenon to the class. In educational research, a phenomenon is an expression that emphasizes the objective reality of a tangible, testable, concrete event or process perceived by the senses. It is also used to reveal what different individuals understand from the same concept (Prosser & Trigwell, 1997). In this study, the phenomena were selected from events that students frequently encounter in their daily lives. The purpose of including a real-life event from their own experiences was to determine the influence of their conceptual formation on the world based on the experiences and to uncover different perspectives they might have towards an event encountered in a laboratory or in nature (Kaya, 2014). After introducing the phenomenon, the students expressed their predictions by raising their hands. They then wrote their thoughts in the "Predict" section of the PECED paper. No interference was made with the students' thoughts to allow them to make as many predictions as they desired. Meanwhile, the researcher wrote the students' predictions on the board. The students were then asked to explain the reasons for their predictions. After expressing their justifications orally, the students wrote them in the second section of the PECED paper, titled "Explain." Additionally, it was mentioned that in this section, students could make drawings or create tables in the "Draw" section of the PECED paper while expressing their justifications.

Subsequently, the researcher conducted the phenomenon to enable the students to observe and collect data. For this purpose, the experimental setups mentioned in the data collection sections of the PECED paper were prepared, educational games were played, or videos were shown. While all the experiments were conducted by the researcher, the educational games were carried out among the students. The students wrote their thoughts based on their observations in the "Explain" section of the PECED paper. In this section, they were also asked to redraw the information they obtained. Finally, the initial drawings made at the beginning of the class were compared with the final drawings, and a general conclusion was reached. Up until this section, there was no transition to argumentation in the study.

In the "Discussion and Construction" phase of CKCM, the transition to argumentation was made. During this phase of the lesson, the exchange of ideas mainly took place between students, while the researcher assumed the role of a guide. The researcher transformed the written predictions on the board into phenomenographic categories in a way that students could understand, and connected them to the specified achievements and objectives of the program. These categories were written on the board as competing theories. Subsequently, each category was given a name (label). In competing theories, students were presented with an event, observation, or problem. Then, two or more theories regarding the resolution of the situation were presented. Students, in small groups, would defend one theory based on their prior knowledge and the evidence presented, while trying to refute the other theory (Tümay, 2008). The aim of transforming predictions into phenomenographic categories was to express that even when students say similar things, what they imply can be significantly different from each other. Furthermore, students can express similar thoughts using quite different terms (Bowden, 1994).

The presented competing theories were examined by the students for a while. Then, the students who agreed on the same idea formed small thought groups consisting of 3-4 individuals, selecting theories that aligned with their ideas. The students defended their ideas through arguments they constructed with various data and justifications, aiming to persuade and refute the opposing groups' theories. Decisions on the defended or refuted competing theories were made through teacher-student collaboration. In the "Extension and Application" phase of CKCM, socioscientific issues relevant to the lesson's attainment were presented to the class through the smart board or the internet. Socioscientific issues are topics that vary according to societies and are difficult to make decisions about (Sadler, 2004). Therefore, when deciding on socioscientific issues, scientific inquiries should be made (Kolsto et al., 2006). Additionally, when selecting socioscientific issues, they should address current topics. This is because students can express their ideas better when it comes to topics that interest them and that they have seen, known, or witnessed in their surroundings. In this context, in this study, socioscientific issues were selected considering their relevance to current events, their potential for debate, and their suitability for the students' level." The distribution of socioscientific issues presented to students throughout the weeks in the study is provided in Table 4.

Table 4. Distribution of Socioscientific Issues Presented to Students by Weeks in the Study.

Weeks	Socioscientific Issues
1. Week	Hydraulic Brake System
	Water cycle
2. Week	Separation of Crude Oil
3. Week	Blood Analysis with Centrifuges
4. Week	Melting of Glaciers
	Solar panels
5. Week	Alternative Thermal Insulation Materials
6. Week	Energy-saving
	Renewable energy sources

Weeks	Socioscientific Issues
7. Week	Air pollution
	Carbon monoxide poisoning

During the "Reflection and Evaluation" phase of the Collaborative Knowledge Building Model, student PECED papers, argumentation levels, and in-class activities were used as in-class assessment tools, while student journals and mini-projects were used as out-of-class assessment tools.

Application Process in the Control Group

In the assigned control group, the lessons were conducted according to the 2018 Science Curriculum as prescribed by the Ministry of Education. In this curriculum, lessons are designed to be learner-centered in order for students to acquire knowledge permanently. The program emphasizes research-based inquiry learning strategies, aiming to develop students' skills in exploration, inquiry, and argumentation. Students in these learning environments feel comfortable expressing their ideas and can articulate themselves verbally, in writing, and visually (MEB, 2018).

During the implementation period in the control group, traditional instruction, large and small group discussions, educational games, and question-answer techniques were employed. Activities were conducted using the smart board and internet, including interactive tasks, solving online questions, and watching videos. To reinforce students' learning, question banks and online quizzes were used at the end of each topic, and puzzle activities and in-class quizzes were organized. At the end of the lessons, the researcher summarized the topic to conclude the class. Throughout these activities, students actively engaged in predicting, testing their predictions, providing explanations, and expressing their thoughts and findings. Furthermore, students demonstrated their abilities to ask questions and discover new things related to a given phenomenon.

Data Analysis

SPSS-22 software package was used for the analysis of quantitative data. An independent samples t-test was conducted to determine if there was a significant difference between the pre-test scores of the groups. Pearson correlation analysis was used to examine the relationship between pre-tests and post-tests. To determine if there was a statistically significant difference between the post-tests, ANCOVA assumptions were tested. ANCOVA is a technique that allows statistical control of another variable or variables that are related to the dependent variable and called covariates, in addition to the independent variable whose effect is investigated in a study. ANCOVA is generally used to test whether there is a significant difference between the post-test measurements of the experimental and control groups in pre-test post-test control group designs (Büyüköztürk, 1998). Pre-test measurements were defined as the common variable in this study. Given that the necessary assumptions were met, ANCOVA was employed to perform the required analyses between the post-tests. To identify the source of the difference between the post-tests, Post Hoc Bonferroni analysis was conducted as a follow-up control analysis. Bonferroni analysis is one of the commonly used multiple comparison tests.

The arithmetic means of the obtained pre-test scores and the post-test scores after the study were presented in a line graph. Then, repeated measures ANOVA analysis was conducted to determine if there was a significant difference between the pre-test, post-test, and follow-up test scores of the experimental and control group students who participated in the research. This technique is used to determine if the mean scores of two or more related measurements significantly differ from each other (Büyüköztürk, 2010).

FINDINGS

This section presents the findings and interpretations of the sub-research problem "Does the 6th-grade science lesson on the 'Matter and Heat' unit, taught according to the Common Knowledge Construction Model and the 2018 Science Curriculum, have an impact on students' academic achievement?"

Descriptive data regarding the pre-MHAT and post-MHAT scores of the experimental and control groups are provided in Table 5.

Table 5. Descriptive Statistics of the Pre-MHAT and Post-MHAT Scores for the Groups

Groups	N	Pre-MHAT		Post-MHAT	
		$\bar{X}$	sd	$\bar{X}$	sd
Experimental	24	6,37	2,65	10,54	3,32
Control	24	5,33	2,97	7,54	3,66

As seen in Table 5, the experimental group's arithmetic means and standard deviation values for the academic achievement test have shown a greater increase compared to the control group. To determine whether the data follows a normal distribution, a normality test was conducted on the pre-MHAT scores of both the experimental and control groups. The results of the normality test analyses for the pre-MHAT scores of the groups are presented in Table 6.

Table 6. Normality Test Results for the Pre-MHAT Scores of the Groups

Groups	Tests	Kolmogorov-Smirnov	Shapiro-Wilk
Experimental	Pre-MHAT	0,200	0,368
Control	Post-MHAT	0,200	0,493

As shown in Table 6, according to the Kolmogorov-Smirnov and Shapiro-Wilk values, normal distribution is observed in both the experimental and control groups ($p>0.05$). The analysis continued using parametric tests. Subsequently, an independent samples t-test analysis was conducted to determine whether there was a statistically significant difference between the groups in terms of pre-MHAT scores. The findings of this analysis are presented in Table 7.

Table 7. Independent Samples t-Test Analysis Results for the Pre-MHAT Scores of the Groups.

Variable	Groups	$\bar{X}$	sd	t	df	p
Pre-MHAT	Experimental	6,37	2,65	-1,281	46	0,207
	Control	5,33	2,97			

The findings in Table 7 indicate that there is no statistically significant difference in the mean scores of the experimental and control groups on the pre-MHAT ($p=0.207$; $p>0.05$). To determine if there was a difference between the groups' post-test scores while controlling for the effect of pre-tests, the data was analyzed using ANCOVA. Therefore, the assumptions of ANCOVA were examined. The assumptions of ANCOVA include the dependent variable showing a normal distribution, homogeneity of variances across groups, and a linear relationship between the dependent variable and the covariates. To have a linear relationship between the dependent variable and the covariates, there needs to be either a statistically significant difference in the means of the pre-test scores between the groups or a statistically significant relationship between the means of the pre-test and post-test scores. Therefore, the first assumption of ANCOVA, which is the normal distribution of the dependent variable, was examined in this study. The normality test analyses for the dependent variable, which is the post-MHAT, are presented in the table below.

Table 8. Normality Test Results for the Post-MHAT Data of the Groups

Groups	Tests	Kolmogorov-Smirnov	Shapiro-Wilk
Experimental	Pre-MHAT	0,187	0,191
Control	Post-MHAT	0,200	0,396

Upon examining the Kolmogorov-Smirnov and Shapiro-Wilk values in Table 8, it can be observed that normal distribution is present in both groups ($p>0.05$). Since the first assumption of ANCOVA has been met, the other assumptions were also examined. According to another assumption, for the pre-tests to be used as a covariate, there needs to be a statistically significant difference in the means of the pre-test scores between the groups or a significant relationship between the pre-tests and post-tests. Upon reexamining the data in Table 16, it is evident that $p=0.207$ ($p>0.05$), indicating no significant difference between the pre-tests.

According to Weinfurt (1995), for a variable to be used as a covariate, there should be a statistically significant relationship between the covariates and the dependent variables. Therefore, the relationship between the pre-test and post-test scores was examined. Table 9 presents the results of Pearson correlation analysis between the pre-MHAT and post-MHAT scores for the experimental and control groups.

Table 9. Results of Pearson Correlation Analysis between the Pre-MHAT and Post-MHAT Scores for the Experimental and Control Groups

Pre-MHAT and Post-MHAT	N	Pearson Correlation (r)	Sig. (2-tailed) (p)
	48	0,478	0,001*

According to the information provided in Table 9, the Pearson correlation analysis indicates a statistically significant relationship between the mean scores of students' pre-MHAT and post-MHAT scores ($r=+0.478$; $N=48$; $*p=0.001$; $p<0.01$). After meeting another assumption of ANCOVA, the final assumption was addressed. According to the final assumption of ANCOVA, it is necessary to determine the homogeneity of group variances. The findings of the analysis conducted to examine the homogeneity of variances are presented in Table 10.

Table 10. Results of Levene Test Analysis for the Experimental and Control Groups' MHAT Scores

F	sd1	sd2	p
1,094	1	46	0,301

According to the result of the Levene test presented in Table 10, the obtained p-value of 0.301 ($p>0.05$) indicates that there is no significant difference between the groups. Since all assumptions of ANCOVA have been met, the pre-MHAT scores of the experimental and control group students were taken as the covariate to control for their influence on the post-MHAT scores. Therefore, the post-MHAT data was analyzed using ANCOVA. The findings of the ANCOVA analysis regarding the scores obtained by the groups from the post-MHAT are provided in Table 11.

Table 11. Findings of ANCOVA Analysis for the Groups' Scores from the post-MHAT

Source	The dependent variable	df	Square of Means	F	P	Partial Eta Square
Pre-MHAT	Post-MHAT	1	129,969	13,540	0,001	0,231
Groups	Post-MHAT	1	65,542	6,828	0,012*	0,132

Table 11 indicates that there is a statistically significant difference in the means of the students' scores obtained from the post-MHAT, depending on the applied methods ($p<0.05$). The partial eta-squared value of 0.132 suggests that 13.2% of the variation in the dependent variable is attributed to the intervention. To determine which group benefited from the intervention, the Bonferroni test was conducted, and the results are presented in Table 12.

Table 12. Results of the Bonferroni Test Analysis for the Experimental and Control Groups' Scores in the MHAT.

Group (I)	Group (J)	Difference of Means (I-J)	Standard error	Sig (p)
Experimental group	Control Group	+2,378	0,910	0,012*

*p<0,05

As seen in Table 12, there is a significant difference in terms of academic achievement variable between the experimental group where the Collaborative Knowledge Construction Model was implemented and the control group where the teaching activities were conducted according to the 2018 Science Curriculum (+2.378 in favor of the experimental group) ($p=0.012$; $p<0.05$). Based on this finding, it can be concluded that the Collaborative Knowledge Construction Model has a more positive effect on the academic achievement of 6th-grade students compared to the lessons taught using the existing program.

Findings on the Retention

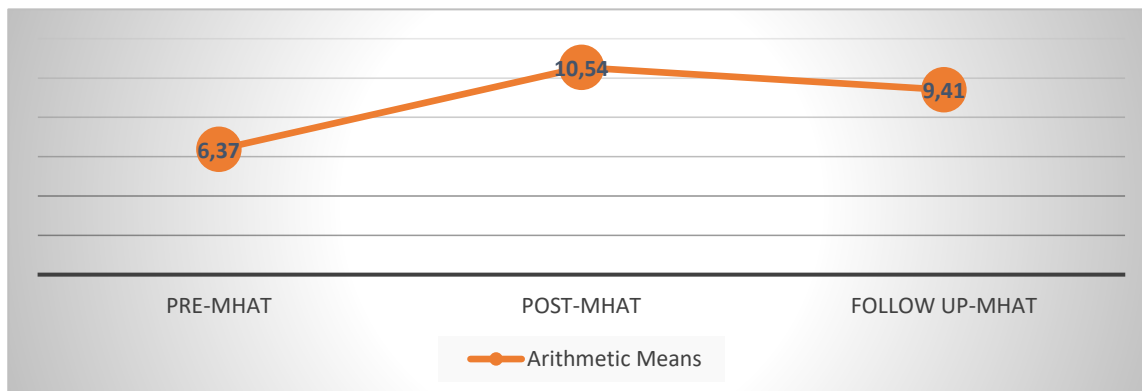
This section presents the analyses of the research problem, "Does the matter and heat unit of the 6th-grade science course, taught according to the Collaborative Knowledge Construction Model and the 2018 Science Curriculum, have a lasting effect on students' academic achievement?" Table 13 provides the descriptive statistics, including the arithmetic means and standard deviations, for the pre-MHAT scores obtained from the experimental and control groups before the intervention, the post-MHAT scores obtained after the intervention, and the follow-up MHAT scores administered to the students after a certain period.

Table 13. Arithmetic Means and Standard Deviations of the Pre-MHAT, Post-MHAT, and Follow-up MHAT Scores of the Groups

Groups	N	Pre-MHAT		Post-MHAT		Follow-up-MHAT	
		$\bar{X}$	sd	$\bar{X}$	sd	$\bar{X}$	sd
Experimental	24	6,37	2,65	10,54	3,32	9,41	2,46
Control	24	5,33	2,97	7,54	3,66	6,62	3,20

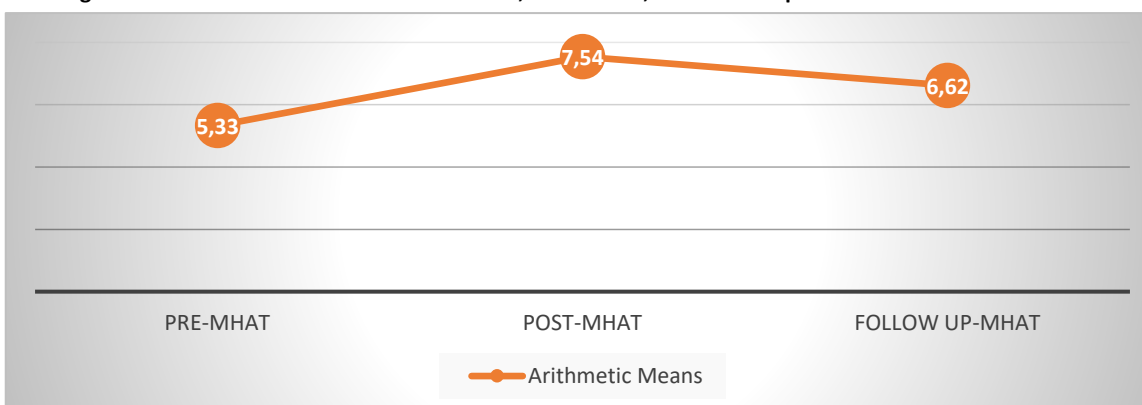
As shown in Table 13, the arithmetic means scores of both the experimental group and the control group increased in the post-MHAT compared to the pre-MHAT scores. However, the arithmetic means scores obtained from the follow-up MHAT decreased slightly compared to the post-test scores. The changes in the tests applied to the experimental group are depicted in Figure 1.

Figure 1. Arithmetic Mean Changes in Pre-MHAT, Post-MHAT, and Follow-up MHAT Scores Applied to the Experimental Group



The changes in the tests applied to the control group are presented in Figure 2.

Figure 2. Changes in Arithmetic Mean Values of Pre-MHAT, Post-MHAT, and Follow-up MHAT Scores for the Control Group



To determine whether to proceed with parametric or non-parametric tests in the study, previous normality test analyses were conducted, indicating that the pre-MHAT and post-MHAT scores of the groups followed a normal distribution. The normality test analyses for the follow-up MHAT scores of the experimental and control groups are provided in Table 14.

Table 14. Normality Test Results for the Follow-up MHAT Scores of the Groups

Groups	Tests	Kolmogorov-Smirnov	Shapiro-Wilk
Experimental	Follow-up- MHAT	0,200*	0,479*
Control	Follow-up- MHAT	0,110*	0,291*

As shown in Table 14, according to the Kolmogorov-Smirnov and Shapiro-Wilk values, both the experimental and control groups exhibit a normal distribution for the follow-up MHAT scores (* $p>0.05$). Since the data follows a normal distribution, parametric tests were used for further analysis. In experimental studies, when there are repeated measurements of the same participants over a specific period of time, a repeated measures ANOVA analysis is conducted (Büyüköztürk, 2010).

In this study, due to the existence of a specific time interval between the post-tests and the follow-up tests, and the use of the same participants, a repeated measures ANOVA test analysis was performed to determine whether there were significant differences among the pre-test, post-test, and follow-up test scores of the experimental and control group students. The repeated measures ANOVA test analyses for the pre-MHAT, post-MHAT, and follow-up MHAT scores of the experimental group are presented in Table 15.

Table 15. Repeated Measures ANOVA Test Results for the Pre-MHAT, Post-MHAT, and Follow-up MHAT Scores of the Experimental Group

Source	Sum of Squares	df	Square of Means	F	Sig (p)	Partial Eta Square
Sphericity Assumption	223,028	2	111,514	20,171	0,000	0,467

In the repeated measures ANOVA test analysis conducted to determine whether there were significant differences among the tests, the assumption of sphericity was examined by looking at the "Sphericity Assumed" values. This value is used to assess the homogeneity of variances.

"Homogeneity of Variance" is a term used to test whether the groups are equivalent or not (Toptaş, 2016). In this case, since the p-value is 0.000; $p<0.05$, we can conclude that the variances are not homogeneous. To determine which group or groups this difference favors, a Bonferroni analysis was conducted in the study. The results of the analysis are presented in Table 16.

Table 16. Bonferroni Test Results for the Pre-MHAT, Post-MHAT, and Follow-up MHAT Scores of the Experimental Group.

Test (I)	Test (J)	Difference of Means (I-J)	Standart Error	Sig (p)
Post-MHAT	Pre-MHAT	4,167	0,789	0,000*
	Follow-up- MHAT	1,125	0,585	0,200
Follow-up- MHAT	Pre-MHAT	3,042	0,647	0,000*

* $p<0,05$

When examining the results of the experimental group presented in Table 16, it can be observed that there is a significant difference between the post-MHAT and pre-MHAT scores, as well as between the follow-up MHAT and pre-MHAT scores ($p=0.000$; * $p<0.05$). On the other hand, the absence of a significant difference between the post-MHAT and follow-up MHAT scores ($p=0.200$; $p>0.05$) indicates that the performance of the experimental group students in these tests is similar even after a certain period of time. This suggests that the retention of the learned information persists. Furthermore, from the findings obtained from the tests applied to the experimental group, it is evident that the students achieved the highest average score in the post-test compared to both the pre-test and follow-up test scores.

The repeated measures ANOVA test analyses for the pre-MHAT, post-MHAT, and follow-up MHAT scores of the control group are presented in Table 17.

Table 17. Repeated Measures ANOVA Test Results for the Pre-MHAT, Post-MHAT, and Follow-up MHAT Scores of the Control Group.

Source	Sum of Squares	df	Square of Means	F	Sig (p)	Partial Eta Square
Sphericity Assumption	59,083	2	29,542	16,389	0,000*	0,416

* $p<0,05$

When examining the assumption of sphericity for the control group, as indicated in Table 17, the "p" value is found to be $p<0.05$. Therefore, in order to determine which group or groups the observed difference favors, a Bonferroni analysis was conducted in the study, and the results are presented in Table 18.

Table 18. Bonferroni Test Analysis Results for the Pre-MHAT, Post-MHAT, and Follow-up MHAT Scores of the Control Group

Test (I)	Test (J)	Difference of Means(I-J)	Standard Error	Sig (p)
Post-MHAT	Pre-MHAT	2,208	0,518	0,001*
	Follow-up- MHAT	0,917	0,294	0,015*
Follow-up- MHAT	Pre-MHAT	1,292	0,310	0,001*

When examining the analysis results for the control group presented in Table 18, it can be observed that there is a significant difference between the pre-MHAT, post-MHAT and follow-up MHAT scores (*p<0.05).

The presence of a significant difference in test scores indicates that the control group students experience differences in terms of the retention of information, particularly in the post-test and follow-up test. This difference suggests that the learned information is forgotten after a certain period or that the applied method does not have an effective impact on the students. Additionally, from the data in Table 18, it can be understood that the control group students obtained higher scores in the post-test compared to both their pre-test scores and follow-up test scores. Therefore, similar to the students in the experimental group, the control group students have achieved the highest mean score in the post-test.

DISCUSSION AND COMMENTARY

In this section, the impact of the Collaborative Knowledge Building Model and the 6th-grade "Matter and Heat" unit, as per the 2018 Science Curriculum, on students' academic achievement was examined, and student perspectives regarding the implementation were discussed. The results of the study indicated that these practices had a positive effect on students' academic performance. These findings are consistent with previous research (Ebenezer et al., 2010; İyibil, 2011; Wood, 2012; Wood et al., 2013; Benli-Özdemir, 2014; Bakırcı and Çepni, 2014; Bakırcı et al., 2015; Ertuğrul, 2015; Akgün et al., 2016; Yıldızbaş, 2017; Bakırcı & Ensari, 2018; Bayar, 2019; Atayeter, 2019; Caymaz & Aydın, 2019; Haydari & Coştu, 2020) that examined the effects of CKCM on students' academic achievements at different grade levels. The main reason for this outcome is the student-centered nature of CKCM since students are active throughout the process in student-centered models. In this study, students actively participated in the process from the beginning of the lesson. For example, during argumentation practices, they made significant efforts to refute the claims of their peers with opposing views and assert their own claims. They utilized various pieces of evidence for this purpose. Additionally, during argumentation practices, several resources were used. For instance, internet access was utilized through tablet computers, videos were watched on interactive whiteboards, and research was conducted using books by collaborating with one another. Furthermore, through this study, students realized that they could learn in competitive environments during argumentation practices without an atmosphere of absolute winning or losing.

Another significant reason for the positive impact of CKCM on students' academic achievements may be the implementation of PECEd papers throughout the process. These papers include visuals such as engaging stories, case examples, and images that capture students' attention. The main purpose of using these papers throughout the lesson is not to transfer rote knowledge to students but to develop various thinking skills in them. These papers are also used to uncover students' prior knowledge about the topic, assess their understanding of concepts, and identify the schemas in their minds before moving on to argumentation practices (Caymaz, 2018). In this study, students utilized PECEd papers during the lessons and wrote down the information they acquired on these papers. The findings from the study demonstrated an increase in the number of correct answers in the explanation and drawing sections at the end of all PECEd paper activities throughout the process. In other words, students utilized the information they learned during the lesson to make revisions in the "Explain" and "Draw" sections of the PECEd papers. The fact that students made revisions indicates progress in their decision-making and problem-solving skills. A similar study conducted by Karabal (2018), which resembled the results of this study, examined the effects of CKCM on prospective science teachers' problem-solving and decision-making tendencies in the teaching of socioscientific issues. The study addressed socioscientific topics such as genetic studies, biological diversity, global warming, nuclear energy, and hydroelectric power plants. The results indicated that in the class where the lessons were taught based on CKCM, prospective teachers showed statistically significant improvement in their decision-making, problem-solving, and self-confidence tendencies. In another study, Haydari and Coştu (2021) investigated the impact of an education program designed in accordance with CKCM on fifth-grade students' problem identification and problem-solving skills in the science lesson on "Biodiversity." The research concluded that CKCM was effective in enhancing students' problem identification and problem-solving skills.

When comparing the academic achievement monitoring test scores of the experimental group students with their post-test scores, there was no significant difference in favor of any test. The lack of significant differences between the tests indicates that students' academic achievements in the post-test and the monitoring test were similar. Therefore, it can be concluded that the learning acquired through the CKCM practices applied to the experimental group remained sustainable even after a certain period of time. This result is parallel to the study conducted by Bakırcı et al. (2015), which examined the impact of CKCM on the sustainability of students' academic achievements. Another study by Yıldızbaş (2017) on this topic investigated the effect of CKCM-based learning on the sustainability of students' learning and found that students retained the knowledge they acquired about the topic of light even after a certain period of time. This student-centered model, which includes numerous examples from daily life, incorporates educational games during lessons, and involves activities such as experiments that enable students to learn through hands-on experiences, has also contributed to the sustainability of the learned information.

When comparing the academic achievement monitoring test scores of the control group, where the lessons were taught according to the 2018 Science Curriculum, with their post-test scores, a significant difference was found in favor of the post-test. The presence of a significant difference between the tests, favoring the post-test, can be interpreted as the information taught in the lessons based on the 2018 Science Curriculum being forgotten by students after a certain period of time or the applied method not leaving a lasting impact on students. This finding contradicts the results obtained by Caymaz (2018). In Caymaz's study, where

the control group received lessons according to the 2013 Science Curriculum, which is also a student-centered program, and the experimental group received lessons based on CKCM, the findings indicated that both the control and experimental groups showed sustained achievement in the post-tests.

RESULTS AND RECOMMENDATIONS

The main result obtained from this study is that sixth-grade students' academic achievement is more effective in lessons taught according to the CKCM compared to the instructional practices included in the 2018 Science Curriculum. Therefore, conducting similar studies in different educational levels would contribute significantly to the relevant literature.

Another important result obtained from this study is the improvement demonstrated by students during argumentation practices. Initially, students were not able to reach advanced levels in the arguments they produced, but as the weeks progressed, they were able to generate arguments at higher levels. This result indicates that students lacked sufficient knowledge and experience in argumentation-based learning methods at the beginning, but their experience increased over time. Therefore, educators who implement the Common Knowledge Construction Model in their lessons should emphasize the content of the topic as much as possible during argumentation practices and create classroom environments that encourage students to collaborate. Additionally, since a significant amount of time is allocated to argumentation-based learning in the CKCM, careful planning is required to utilize this time effectively. Therefore, when planning, the selection of stories and scenarios should be tailored to the educational levels of the students, as this will also affect the course of the discussions.

Moreover, the findings of the study indicate that students found the Common Knowledge Construction Model interesting, engaging, and enjoyable. Considering the contributions of the CKCM to students, it can be observed that the model actively engages students throughout the process. Therefore, activities included in lessons according to the CKCM should be appropriate, practical, and applicable to the students' level. To achieve this, it is crucial to prepare the PECED papers used during the process meticulously, incorporate more visual elements into these papers, and include real-life examples. However, since some students may not enjoy writing or drawing, oral responses can also be considered instead of written materials. Additionally, preparing and distributing all materials and learning resources by the teacher before the implementation will help overcome any time constraints during the activities.

It is a well-known fact that using instructional materials in science education enhances students' interest in the subject. Therefore, researchers who will implement the CKCM in their lessons are advised to use rich materials in their instructional environments. Moreover, teachers should inform students about the use of technological tools such as tablets and smart boards effectively before the process. In this context, informative videos about challenging and hazardous experiments should be shown to students before the activities. This will prevent any potential negative incidents. The importance of group work should also be emphasized to students during CKCM practices. Students feel more comfortable when they are in an environment where they respect each other's ideas and can freely express their own thoughts. In this regard, educators should create a democratic atmosphere in their classrooms, value all students' opinions related to the topic, and provide guidance throughout the process. Therefore, educators should create more time and opportunities for students to collaborate in their classrooms.

In this study, it was determined that students' academic achievements continued to be retained even after a certain period of time based on the results obtained from the retention tests. The findings from the interviews also revealed that students established strong connections between the concepts covered in the lessons and everyday life. Therefore, educators who will utilize the CKCM should incorporate more expressions and examples from daily life in their lessons. This will help students overcome thoughts like 'What difference does it make if I learn this?'

This research was conducted in the 6th-grade science class during the "Matter and Heat" unit. The same study can be implemented in different units of the 6th-grade science class, allowing for comparisons between class levels. Furthermore, it is recommended to use the CKCM in other subjects as well, as it has positive effects on students' cognitive, affective, and psychomotor learning. The research was carried out in a school located in the district center. To diversify the data obtained, similar studies can be conducted in rural schools and in schools where scientific studies are less common. Additionally, researchers are advised to conduct thorough preliminary research when determining the sample group. Choosing schools that support scientific studies could be another recommendation.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

The research proposal titled "Investigation of common information structure model applications towards matter and heat unit of secondary school 6th grade in terms of various variables" was discussed and unanimously accepted at the meeting of Manisa governorship national education directorate ethics committee commission dated 27.11.2018 and numbered 6792. The approval code of the study is 46949512-605.01-e.22713582.

REFERENCES

- Akgun, A., Duruk, U. and Gülmez-Güngörmez, H. (2016). Views of sixth grade students on the common knowledge construction model, *Amasya University Journal of Education Faculty*, 5(1), 184-203.
- Atater, M. (2019). The effect of common knowledge structuring model on the academic achievement and attitudes of middle school 4th grade students in the unit of the structure and properties of matter in science course, *Master Thesis, Muğla Sıtkı Koçman University Institute of Educational Sciences*, Muğla.
- Bakırcı, H. and Çepni, S. (2012). A new model for science and technology teaching: Common knowledge construction model, *X. National Science and Mathematics Education Congress*, Niğde University, Niğde.
- Bakırcı, H. and Çepni, S. (2014). Examination of the common knowledge construction model on the basis of the science curriculum, *Journal of Science Education*, 2(2), 83-94.
- Bakırcı, H., Çepni, S., and Ayvaci, H. Ş. (2015). Science teachers' opinions about the common knowledge construction model, *Yüzüncü Yıl University Journal of Education Faculty*, 12(1), 97-127.
- Bakırcı, H. and Ensari, Ö. (2018). The effect of the common knowledge construction model on the academic achievement and conceptual understanding of high school students about heat and temperature, *Education and Science*, 43, 196.
- Bayar, M. F. (2019). The effect of common knowledge construction model on science process skills and academic achievement of secondary school students on solar system and eclipse, *Online Science Education Journal*, 4(1), 4-19.
- Benli-Ozdemir, E. (2014). Examining the effects of common knowledge construction model in science teaching on cognitive and affective learning of primary school students, *PhD Thesis, Gazi University Institute of Educational Sciences*, Ankara.
- Biernacka, B. (2006). Developing scientific literacy of grade five students: A teacher researcher collaborative effort, *Unpublished Ph.D. Dissertation, University of Manitoba, Canada*.
- Bowden, J. A. (1994). *The nature of phenomenographic research*, *Phenomenographic Research: Variations in a method*, Eds.: J. A. Bowden & E. Walsh, The Warburton Symposium, Royal Melbourne Institute of Technology, Melbourne, 1-16.
- Bozkurt, O., Ay, Y. & Fansa, M. (2013). The effects of inquiry-based learning on students' science achievement and on their attitudes towards science and students' opinions about the implementation of the method in the teaching process. *Abant İzzet Baysal University Faculty of Education Journal*, 13(2), 241-256.
- Büyüköztürk, S. (2004). *Data analysis handbook (20th Edition)*, Pegem A Publishing, Ankara.
- Büyüköztürk, S. (2010). *Data analysis handbook for social sciences*, Pegem A Akademi, Ankara.
- Caymaz, B. (2018). Investigation of the effect of common knowledge structuring model in teaching 7th grade electrical energy unit in schools with different socio-economic levels, *PhD Thesis, Kastamonu University Institute of Science and Technology*, Kastamonu.
- Caymaz, B., & Aydin, A. (2021). The effect of common knowledge construction model-based instruction on 7th grade students' academic achievement and their views about the nature of science in the electrical energy unit at schools of different socio-economic levels. *International Journal of Science and Mathematics Education*, 19(2), 233-265.
- Cresswell, J.W. (2003). *Research design: Qualitative, quantitative and mixed methods approaches* (2nd ed.), Sage Journals, Thousand Oaks, California.
- Çalık, M. and Cobern, W. W. (2017). A cross-cultural study of CKCM efficacy in an undergraduate chemistry classroom, *Chemistry Education Research and Practice*, 18(4), 691-709.
- Demirel, O.E. (2014). Effects of problem based learning and argumentation based learning on the chemistry achievement mixtures unit, their science process skills and science reasoning aptitudes. *Master's Thesis, Mustafa Kemal University Social Sciences Institute*, Hatay.
- Demirel, O. E. (2022). Examination of the common knowledge construction model applications for the 6th grade "matter and heat" unit in terms of various variables. *Ph. D. Dissertation. Uşak University Graduate Education Institute*, Uşak.
- Demirel, O. E. (2024a). Understanding the Nature of Critical Thinking and Academic Achievement: An Analysis within the Scope of Science Education, *Journal of Interdisciplinary Educational Research*, 8(17), 75-86, DOI: 10.57135/jier. 1447227

- Demirel, O.E. (2024b). The effect of scientific reasoning skills of male and female students in 7th grade science course on life-based success. Bay, E. and Ozturk, G. (Eds.). International Research and Evaluations in Science Education (pp. 35-52). Ankara Seruven Publications.
- Demirel, O. E. & Türkmen, L. (2023). Student opinions on the use of common knowledge construction model (CKCM) in science and technology lessons. *Anatolian Turkish Journal of Education* 5 (1), 29-53.
- Duschl, R. A. and Osborne, J. (2002). Supporting and promoting argumentation discourse in science education, *Studies in Science Education*, 38, 39-72.
- Ebel, R. L. (1965). *Measuring educational achievement*, Prentice-Hall, Englewood Cliffs, New Jersey.
- Ebenezer, J.V. and Connor, S. (1999). *Learning to teach science: A model for the 21st century*, Prentice-Hall, Upper Saddle River, New Jersey.
- Ebenezer, J.V. and Fraser, D. M. (2001). First year chemical engineering students' conceptions of energy in solution processes: Phenomenographic categories for common knowledge construction, *Science Education*, 85(5), 509–535.
- Ebenezer, J.V. and Puvirajah, A. (2005). WebCT dialogues on particle theory of matter: Presumptive reasoning schemes, *Educational Research and Evaluation*, 11(6), 561–589.
- Ebenezer, J.V., Chacko, S., Kaya, O. N., Koya, S. K. and Ebenezer, D. L. (2010). The effects of common knowledge construction model sequence of lessons on science achievement and relational conceptual change, *Journal of Research in Science Teaching*, 47(1), 25–46.
- Ertugrul, N. (2015). The effect of common knowledge structuring model on learning products in science teaching, *Master Thesis, Kırıkkale University, Institute of Science and Technology*, Kırıkkale.
- Iyibil, U. (2011). A new approach for teaching 'energy' concept: The common knowledge construction model, *Western Anatolia Journal of Educational Sciences (WAJES)*, *Dokuz Eylül University Institute*, Turkey. <http://hdl.handle.net/20.500.12397/5147>
- Karabal, M. (2018). The effect of the Common Knowledge Construction Model on the decision-making and problem-solving tendencies of prospective teachers in the teaching of socioscientific issues, *Pamukkale University Institute of Educational Sciences*, Denizli.
- Karasar, N. (2010). *Scientific research method, 21st Edition*, Nobel Yayın Dağıtım, Ankara.
- Kaya, Z. (2014). The effect of blended learning on the development of pre-service science teachers' technological pedagogical content knowledge and classroom teaching skills on global warming, *Ph.D. Thesis, Fırat University Institute of Educational Sciences*, Elazığ.
- Kolsto, S. D., Bungum, B., Arnesen, E., Isnes, A., Kristensen, T., Mathiassen, K., Mestad, I., Quale, A., Tønning, A. S. V. and Ulvik, M. (2006). Science students' critical examination of scientific information related to SSI, *Science Education*, 90, 632-655.
- Ministry of National Education (MEB). (2018). *Science curriculum (primary and secondary school 3rd, 4th, 5th, 6th, 7th and 8th grades)*, Board of Education and Discipline, Ankara.
- Pedretti, E. (1999). Decision making and STS education: Exploring scientific knowledge and social responsibility in schools and science centers through an issue-based approach, *School Science and Mathematics*, 99(4), 174-181.
- Prosser, M. and Trigwell, K. (1997). Relations between perceptions of the teaching environment and approaches to teaching, *British Journal of Educational Psychology*, 67, 25-35.
- Sadler, T. D. (2004). Informal reasoning regarding socio-scientific issues: a critical review of research, *Journal of Research in Science Teaching*, 41, 513-536.
- Tekin, H. (2000). *Assessment and evaluation in education (14th Edition)*, Judicial Publishing House, Ankara.
- Topçu, M. S. (2015). *Socioscientific issues and teaching*, Pegem Academy, Ankara.
- Toptaş, V. (2016). Opinions of prospective classroom teachers on the use of interactive whiteboards, *Kırıkkale University Journal of Social Sciences*, 6(2), 117-130.
- Tumay, H. (2008). Argumentation-oriented chemistry teaching, *PhD Thesis, Gazi University Institute of Educational Sciences*, Ankara.
- Tuysuz, C. & Demirel, O. E. (2020). Probleme ve argümantasyona dayalı öğrenme yöntemlerinin “karışımlar” konusundaki etkilerinin incelenmesi. *Muğla Sıtkı Koçman University Institute of Educational Sciences*, 7(1), 43-61.
- Tuysuz, C., Demirel, O. E., & Yildirim, B. (2013). Investigating the effects of argumentation, problem and laboratory based instruction approaches on pre-service teachers' achievement concerning the concept of “acid and base”. *Procedia-Social and Behavioral Sciences*, 93, 1376-1381.
- Tuysuz, C., Yildirim, B. ve Demirel, O., E. (2014). The Effects of Argumentation, Problem and Laboratory Based Learning Methods in Chemistry Lectures on Pre-Service Primary Teachers' Scientific Process and Critical Thinking Skills, *Pensee Journal*, 76(3), Part no: 2, 401-408.

- Vygotsky, L. (1987). *The collected works of Vygotsky: Problems of general psychology, including the volume thinking and speech*, Eds: R. W. Rieber and A. S. Carton, Plenum Press, New York.
- Walker, A. K. and Zeidler, L. D. (2007). Promoting discourse about socioscientific issues through scaffolded inquiry, *International Journal of Science Education*, 29(11), 1387-1410.
- Weinfurt, K. P. (1995). *Multivariate Analysis of Variance, Reading and Understanding Multivariate Statistics*, Eds.: L. G. Grimm and P. R. Yarnold, American Psychological Association, Washington D.C., US, 245-276.
- Wood, L. C. (2012). Conceptual change and science achievement related to a lesson sequence on acids and bases among African American alternative high school students: A teacher's practical arguments and the voice of the "other", *Unpublished Ph.D. Dissertation, Wayne State University, Michigan*.
- Wood, L. C., Ebenezer, J. and Boone, R. (2013). Effects of an intellectually caring model on urban African American alternative high school students' conceptual change and achievement in chemistry, *Chemistry Education Research and Practice*, 14(4), 390-407.
- Yıldızbaş, H. (2017). The effect of teaching based on common knowledge construction model on students' academic achievement and critical thinking skills, Master Thesis, *Necmettin Erbakan University, Institute of Educational Sciences, Konya*.

Appendix 1

TINY RAINDROP

There was a Tiny Raindrop who was curious about everything. Everyone loved this cute Raindrop. Because there was no one cuter or smarter than him in the sky.



One day, while Raindrop was wandering in the sky, he saw the angry Sun. The sun said to him: "Hey tiny Raindrop, don't come any closer to me, it wouldn't be good for you."

Not knowing what to do, Raindrop did what the Sun said and continued on his way. While he was on the road, he encountered "Cold Weather" this time. Cold Weather said the same thing: "Hey tiny Raindrop, don't hang around here too much, it won't be good for you."



PREDICT

Why do you think the sun and the cold weather might have warned Raindrop?

.....

.....

.....

EXPLAIN

Explain the reasons for your predictions.

.....

.....

.....

COLLECT DATA

Let's do a fun experiment with you.

Required materials: Butter, Pot, Tube, Fork, Lighter, Container, Jar Lid and Some water.

Experimental Procedure: Heat some butter in a pot. Then wait for it to cool down and observe.



Then put some water into the container and light the bottom of the tube. Cover the water container with the jar lid. Wait for a while. Close the bottom of the tube and after a while, take the jar lid off the container and observe the situation.

EXPLAIN

Explain the information you obtained from the experiment in your own words.

DRAW

If you wanted to draw with the information you learned in this lesson, what would you draw?

Arguments You Created



| Research Article / Araştırma Makalesi |

Determination of Cognitive Structures of Primary School Fourth-Grade Students on the Concept of Recycling

İlkokul 4. Sınıf Öğrencilerinin Geri Dönüşüm Kavramına İlişkin Bilişsel Yapılarının Belirlenmesi

Enver TÜRKSOY¹, Gülşen ALTINTAŞ²

Keywords

1. Environmental education
2. Misconception
3. Primary School
4. Recycling

Anahtar Kelimeler

1. Çevre eğitimi
2. İlkokul
3. Geri dönüşüm
4. Kavram yanlışlığı

Received/Başvuru Tarihi
07.09.2022

Accepted / Kabul Tarihi
25.07.2025

Abstract

Purpose: In this study, it was aimed to determine the cognitive structures of primary school 4th grade students regarding the concept of recycling

Design/Methodology/Approach: In the research, the phenomenology design, which is one of the qualitative research designs, was used. The participants of the study consisted of 150 fourth grade students in the central district of Demirci district of Manisa province. In order to determine the cognitive structures of primary school fourth grade students regarding the concept of recycling, expert opinion was taken, and the word association form prepared by the researcher was used as a data collection tool. The responses of the fourth-grade primary school students to the key concept of "Recycling" were examined. For the key concept, main categories were created, and answer words were placed in line with the answer words given, considering the recycling stages determined in line with the "Zero Waste" project implemented by the Ministry of Environment and Urbanization in 2017, in order, appropriate categories. The answers given by the students to the key concept with the word association form were examined in detail for analysis, first descriptive analysis was made, codes were determined, and cognitive levels were determined by content analysis. The data obtained were analysed using the number of words, the number of answers and the semantic relationship technique. A frequency table was created for the scientific and non-scientific sentences of the key concept.

Findings: According to the results obtained in the study, the number of words that primary school students associate with concepts related to recycling is high. In the study, it is seen that the concept of "recycling" creates meaningful sentences at the word level, and the sentences contain some misconceptions at the sentence level. In the sentences they create about the concept of recycling, there are misconceptions such as everything can be recycled, unused items can be recycled, old things can be renewed.

Highlights: It was observed that students often confuse the concepts of "recycling" and "reusability," and this misconception is reflected throughout the findings. Additionally, some students hold incorrect beliefs, such as the idea that all materials can be recycled or that used items automatically become recyclable. These misconceptions may hinder the development of a scientifically accurate understanding of recycling.

Öz

Çalışmanın amacı: Bu çalışmada ilkököl dördüncü sınıf öğrencilerinin geri dönüşüm kavramına ilişkin bilişsel yapılarının belirlenmesi amaçlanmıştır.

Materyal ve Yöntem: Araştırmada nitel araştırma desenlerinden fenomenoloji deseni kullanılmıştır. Araştırmanın katılımcıları Manisa ili Demirci ilçesinde öğrenim gören 150 dördüncü sınıf öğrencisi oluşturmuştur. Araştırma verileri araştırmacılar tarafından uzman görüşleri alınarak hazırlanan kelime ilişkilendirme formu ile toplanmıştır. Araştırma verileri içerik analizi yöntemi ile analiz edilmiştir. Veri kodlama süreci araştırmacılar tarafından bağımsız bir şekilde ve eşzamanlı gerçekleştirilmiştir. Öğrencilerin kelime ilişkilendirme formu ile anahtar kavrama verdikleri cevaplar analiz için detaylı olarak incelenmiş, ilk olarak betimsel analiz yapılmış, kodlar belirlenmiş ve içerik analizi ile bilişsel düzeyleri belirlenmiştir. Elde edilen veriler kelime sayısı, cevap sayısı ve anlamsal ilişki tekniği kullanılarak analiz edilmiştir. Anahtar kavramın bilimsel ve bilimsel olmayan cümleleri için frekans tablosu oluşturulmuştur. Ayrıca elde edilen bulgular içerisinde yer alan kavram yanlışlıkları belirlenmeye çalışılmıştır.

Bulgular: Araştırmada elde edilen sonuçlara göre ilkököl öğrencilerinin geri dönüşüm ile ilgili kavramlarla ilişkilendirdikleri kelime sayısı fazladır. Çalışmada "geri dönüşüm" kavramının kelime düzeyinde anlamlı cümleler oluşturduğu, cümlelerin ise cümle düzeyinde bazı kavram yanlışlıkları içerdiği görülmektedir. Geri dönüşüm kavramı ile ilgili oluşturdukları cümlelerde her şey geri dönüştürülebilir, kullanılmayan eşyalar geri dönüştürülebilir, eskiler yenilenir gibi kavramsal hatalardır.

Önemli Vurgular: Çalışma sonucunda öğrencilerin, "geri dönüşüm" ve "yeniden kullanılabilirlik" kavramlarını karıştırdığı tespit edilmiştir. Ayrıca öğrencilerin bazılarının, geri dönüşümle ilgili her şeyin yeniden dönüştürülebileceği gibi yaygın kavram yanlışlıklarına sahip olduğu görülmüştür. Elde edilen bulgular, bu yanlışlıkların öğrencilere kazandırılmaya çalışılan bilimsel anlayışta ciddi bir engel oluşturabileceğini göstermiştir.

¹ Corresponded Author, Kırşehir Ahi Evran University, Faculty of Health Sciences, Child Development Department, Kırşehir, Türkiye; <https://orcid.org/0000-0003-4321-3017>

² Manisa Celal Bayar University, Faculty of Education, Department of Educational Sciences, Manisa, Türkiye; <https://orcid.org/0000-0002-3394-5903>

INTRODUCTION

The primary school period is one of the important steps in acquiring the necessary information, developing the skills and transforming all these abilities into behaviour. The child uses the knowledge, skills and behaviours gained in this process to recognize both themselves and society. Primary school provides an environment that will increase the child's skills and contribute to their development as individuals who are beneficial to themselves and the society.

Attitudes and behaviour developed by the child in primary school; If they can be developed in a positively toward the environment, they can take on an important mission in increasing responsibilities toward themselves, society and the environment in later years. Children in this period are very attentive to changes in their environment. They have a high interest in learning and are very energetic. If these developmental characteristics are supported positively, research skills can be increased. Therefore, children who are interested in research try exploring the environment by asking questions about their environment.

Society needs environmentally sensitive and conscious individuals. Protecting the environment, knowing environmental responsibilities and transforming them into behaviour can be achieved with environmental education. The main purpose of environmental education is; to support people's interest in nature (Bahl et al., 2016; Güven & Yılmaz, 2017; Jickling & Walls, 2019) to teach the language of nature (Saraç, 2017). Environmental education beginning at an early age can be more effective (Erol, 2016; Güneş, 2018; Yılmaz et al., 2020). Environmental education is an effective way to focus on environmental issues.

The environmental knowledge and awareness offered to individuals allows especially knowing and solving environmental problems and develop behaviours to protect the environment. Recycling is one of the effective methods for protecting the environment. The recycling of used materials is getting more and more important every day. This process has accelerated because of the enrichment of the technological infrastructure of industrialization. Increasing population, rapid urbanization and diversification of human activities increase the degradation of the environment. However, the increase in the amount of garbage, its types and risk threaten human and environmental health. Environmental disasters, which are heard almost every day, draw attention around the world and in our country. Burying or burning used products, which are generally regarded as garbage, is seen as the most preferred method (Muisse et al., 2016). Additionally, the activities to be carried out at the stages such as collection, storage, reprocessing and back distribution that will occur after the products reach the consumer is gaining importance day by day. Recycling is the reuse of various waste materials (glass, paper, concrete, organic waste and electronic waste, aluminum, plastic, battery, motor oil, accumulator, etc in the production process, which are converted into secondary raw materials either by chemical, physical, or physical-chemical processes (Büyüksaatçi et al, 2008). The main purpose of recycling is to reduce the amount of garbage, reuse waste and prevent unnecessary use of resources (UNESCO, 1992). Therefore, it is considered sustainable as an important part of the future (Edgell, 2016; Henschion et al., 2017; Wichaisri & Sopadang, 2018).

When the literature was examined, it was found that the attitudes of students toward the environment regarding recycling (Boca & Saraçlı, 2019; Aguilar-Jurado et al., 2019), students' awareness levels (Hammami et al., 2017; Katırcioğlu, 2019), perceptions (Keleş & Keleş, 2018), opinions on waste and recycling (Altıkolatsi et al., 2021; Yoldaş, 2019) were found. When the studies are examined, it is seen that the studies are mostly aimed at the application. This study aims to determine the conceptual perceptions of the elementary school fourth-grade students toward the concept of "recycling."

When the studies conducted are examined, it is seen that the studies are more application oriented. In this study, it is aimed to determine the conceptual perceptions of the elementary school fourth-grade students toward the concept of "recycling." It is considered important to determine the status of the recycling concept and to realize it before the implementation processes. The fact that the study is a phenomenological study is important in terms of revealing the meanings that students attribute to the concept of "recycling." It is seen that there are no similar studies in the literature, and the study differs from other studies in the literature. In the 6th, 7th or 8th grades of secondary school as of the 2022-2023 academic year of the Ministry of National Education. The fact that the existence of wastes will be processed in the content of "environmental education and climate change" course, increases the importance of understanding the concept of recycling (MEB, 2022).

Even though the concept of recycling has been widely used in recently, it is thought that it is not clearly understood and there are misconceptions about this concept. The experiences gained through the lives of the individual, structures that do not comply with scientific facts and are resistant to change form a basis for misconceptions. These fulcrums are also conceptualizing that significantly affect new learning (Pfund & Duit, 1991). A reason for negatively affecting the cognitive structure is the abstract concepts that cannot be fully associated the concepts related to the subject in the mind and individuals can (be explained by their thoughts) because of learning about these concepts (Bjorklund, & Causey, 2017; Friedman & Miyake, 2017; Klahr & Wallace, 2022; Stiles et al., 2015). Some measurement techniques have been developed for individuals to associate the concepts they have with new information. The word association test (WAT) is one of these techniques (Doğan et al, 2018). WAT, which is one of the alternative measurement technique and has been determined that it is used both in the field of science and social fields, is a tool for observing the concepts formed with the cognitive structure, the information network formed in the mind and determining whether the relationships between concepts are sufficient and meaningful (Akyurt, 2020; Onat & Keskin, 2019; Kaya & Taşdere, 2016; Timur et al., 2020).

The "Human and Environment Relationship" unit in the Primary School 4th Grade Science curriculum is "Are we conscious consumers?" The concept of recycling is included. According to the achievements in teaching human and environment in the curriculum, primary school 4th grade students are expected to gain a cognitive structure for understanding the importance of

mutual interaction between human and the environment and the negative effects of environmental pollution on people's health. It is important to reveal the cognitive structure for the concept of recycling in the mutual interaction between humans and the environment. For this reason, it is aimed to determine the cognitive structures of primary school 4th grade students regarding the concept of recycling. For this purpose, it is searched for an answer to the question "What are the cognitive perceptions of primary school 4th grade students toward the concept of recycling?" The sub-questions of the research are,

- Under which conceptual categories can they be grouped according to the similarities and differences between the cognitive perceptions that students produce for recycling?
- Under which conceptual categories can these cognitive perceptions be grouped in terms of their common features?
- What are the scientific, non-scientific and misconceptual expressions of primary school students regarding the key concept of "Recycling"?

METHOD/MATERIALS

In this study, the phenomenology study model, one of the qualitative research methods, is used. While qualitative studies try to reveal how people attribute and interpret meaning to their experiences, the task of phenomenological studies is to describe the basic structure or source of experience (Merriam & Grenier, 2019; Patton, 2014; Yıldırım & Şimşek, 2021). In this study, a phenomenological study was used to determine which concepts the students associate their experiences the concept of "recycling", which is included in the Primary School 4th Grade Science course. The study group of the research participants is the fourth-grade primary school students in the central district of Demirci, Manisa in the 2021-2022 academic year. In the literature, it is seen that the number of participants in phenomenological studies is from one person to 325 participants (Creswell, 2020). For this reason, a group of 150 students was included in the study, considering the research data collection process and the quality of the data to be obtained. Of the students examined, 79 (53%) were female and 71 (43%) were male

Data Collection Tool

To determine the cognitive structures of the primary school fourth-grade students regarding the concept of recycling, expert opinions were taken, and the word association test prepared by the researcher was used as a data collection tool. In the word association test, the concept selection was made based on the key concept of "Recycling" in the "Human and Environment" unit in Chapter 6 of the 4th Grade Science textbook. In the Word Association test, they are expected to write words that they can associate with a concept in a short time. With the word association test, the key concept of "Recycling" was written 10 times one under the other and presented to primary school students and they were asked to write down the words about what it connoted as an answer and to write a sentence about the concept of recycling at the bottom. A key concept can only be associated with a concept at the level of recall, as well as a connotation that does not have a meaningful relationship with the key. A sentence about a key concept requires a higher level of skill than a single word. Whether these sentences are scientific or not and whether they contain misconceptions of different nature can affect the evaluation process (Allen, 2019). Writing down the key concept as much as the expected number of answers; to prevent the risk of chain responses. Instead of writing the answer words that come to mind for the given key concept, the student is to prevent them from writing the word that the answer word can bring to mind. Thus, the test can be prevented from going beyond its purpose. When the research is examined, it is stated that the appropriate response time for the key concept should be 30 seconds (Işıklı et al., 2011; Şimşek, 2013), the reason why the students are in primary school, it was deemed appropriate to give 60 seconds for the key concept (Ercan et al., 2010). First, an example of the word "school" was presented to primary school students, and an example application was made in the classroom to ensure students' understanding.

Then the key concept is presented.

Key Concept: Recycling:..... Recycling:..... Recycling:..... Recycling:..... Recycling:.....

Validity and Reliability Studies

Validity, the investigate phenomenon; attentive, careful and impartial, is the most powerful and decisive criterion to be expressed as it is. Reliability is an important element in qualitative research (Bryman, 2016; Creswell, 2020). In this context, the data obtained from primary school students were analysed separately. The researcher analysed the results of the analysis according to different categories. Additionally, the raw data were examined by two science educators who are experts in their fields. Validity was tried to be ensured by writing in detail how the data were collected and how the results were obtained from the collected data. Reliability: It can be defined as the repetition of a study conducted to measure a certain feature from another study in the same way under similar conditions and yielding similar or the same results. The researcher conducting the study should report in detail and clearly the stages of the study, the process, his/her own position and approach (Bryman, 2016; Merriam & Tisdell, 2015). The answer words given by the primary school fourth-grade students for the key concept of "Recycling" were examined. For the key concept, main categories were created in line with the given answer words, considering the recycling stages determined in line with the "Zero Waste" project implemented by the Ministry of Environment and Urbanization in 2017 and the answer words were placed in the appropriate categories. This process was repeated a week later, and some answer words were shifted to other categories. Two experts validated the categories created for the key concept and the answer. In terms of coder consistency during the coding process, two researchers coded twice with the code-re-code logic. Coding was done by two people

in terms of consistency between the coders. After the coding on the compatibility between the coders, the process of persuasion between the coders was used in case of disagreement. The aim here is to perceive all data are important in qualitative research. During the persuasion process, the two coders tried imposing the correctness of the code they had expressed in the notes they kept on the incompatible codes. In case of incompatibility, the process of recoding and applying to a third coder was made and a third coder's opinion was received for the coding on the "Benefits of recycling" theme.

Data Analysis

The answers given by the students to the key concept with the word association test were examined in detail for analysis, the codes were determined by conducting descriptive analysis first, and the cognitive levels were determined by content analysis. Descriptive analysis is an analysis that is generally based on "invivo," coding as it was, or in accordance with the real logic of the specified concepts, without producing any semantic interpretation in the code creation process. Content analysis is a type of analysis used to analyse the content of any document, numerically or statistically (Bryman, 2016; Merriam & Tisdell, 2015). The main purpose of this analysis was to reveal the relationships that can explain the obtained data. In this process, the data were conceptualized, organized in logically, and the themes that explain the data were created (Bryman, 2016). In the study, students' answer sheets were numbered for content analysis. The obtained data were analysed using the number of words, the number of answers, and the semantic relationship technique. A frequency table was created for the scientific and non-scientific sentences of the key concept. The frequency table was prepared to show how many times that word or concept is used in response to the key concept. The words answered with the same meaning are the most repetitive words. Irrelevant words, unrelated words and repeated words were not evaluated. Words are categorized using semantic relationship criteria. The sentences of the students related to the concept of recycling (S.....) were given with the participant number, and the sentences made by the students were given as a one-to-one quotation without changing the essence. The ethical permission (06.02.2020 /03 numbered) was taken from the ethics committee of Manisa Celal Bayar University, Institute of Social Sciences, to conduct the study. Students whose parents did not give permission for the study /did not receive the consent form and did not want to fill out the questionnaire were excluded from the study and only participated in the training.

FINDINGS

The findings obtained from theses according to the determined criteria are discussed in this section in the order of subproblems. The findings regarding the answer to the question of the first sub-problem, "What is the distribution of theses addressing the subject of 'organizational commitment' in the field of education by year?" are given in Figure 1.

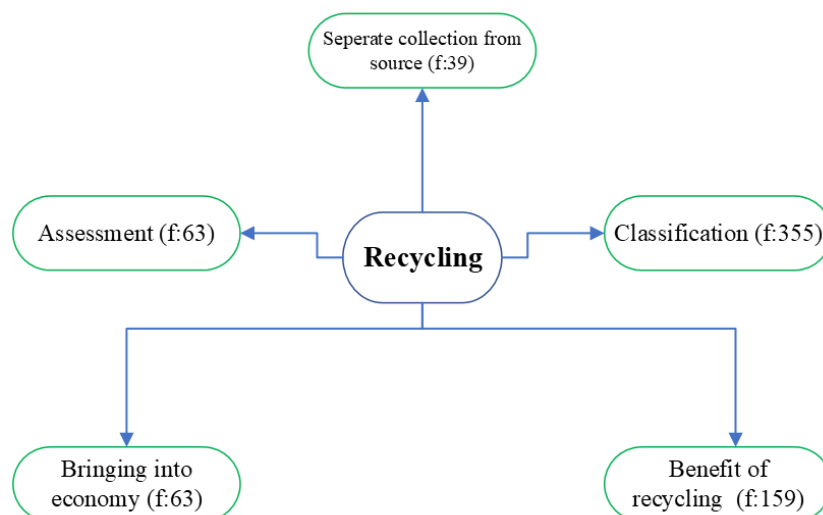


Figure 1. Categories and code distributions obtained from primary school students' perceptions of the concept of "Recycling"

Five different categories related to the concept of "recycling" were formed in the primary school students who participated in the study. The answers received from the primary school students who participated in the study were 39 words belonging to 5 different concepts in the "collection separate from the source" category, 355 words belonging to 7 different concepts in the "classification" category, 97 words belonging to 13 different concepts in the "evaluation" category, 14 words in the "bringing the new product to the economy" category. They created 63 words belonging to different concepts and 159 words belonging to 21 different concepts in the "benefits of recycling" category. A total of 713 words were evaluated under all the categories. A total of 60 concepts were produced in five categories. The category of "benefits of recycling" was the one that produced the most 21 different concepts. However, although 7 different concepts were produced in the "classification" category, it was observed that the category with the highest number of words was produced with 355 total words.

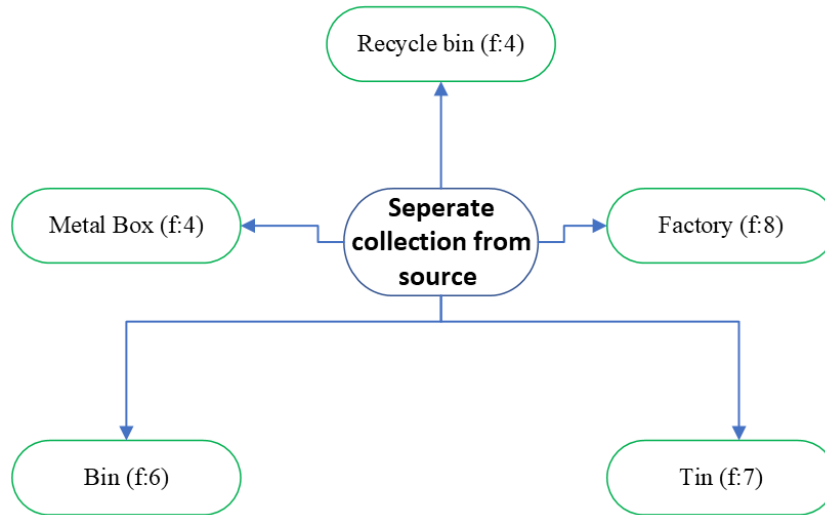


Figure 2. The Response word distributions of the students for the "separate collection from the source" category

In Figure 2., it is determined that the answer words given by the students in the category of " Separate Collection from the Source " were five and the frequency was 39. In this category, the Recycle Bin (14) ranks first among the associations made by primary school students. After that Factory (8), Tin (7), Trash (6), Metal box (4) come. In the category of "Separate Collection from Source"; Container, Piggy bank, indoor boxes, Recycling bags etc. are available. It is thought that the answers in the category of " Separate Collection from the Source " are related to the concept of "Recycling,". Sentences were made for the issue;

- We recycled glass, paper, batteries and plastic items. (M, 22. S)
- We should dispose of wastes in glass, plastic and paper places. (F, 12. S)
- Let's not throw plastic, glass, paper in normal garbage. Garbage separately trashes cans, let's throw them. (F,78. S)
- The class made a presentation by hanging up recycling papers and making a recycling bin. (F,88.S)

When the sentences formed by primary school students in the category of " Separate Collection from the Source " regarding the key concept are evaluated in terms of recycling bins are at the forefront.

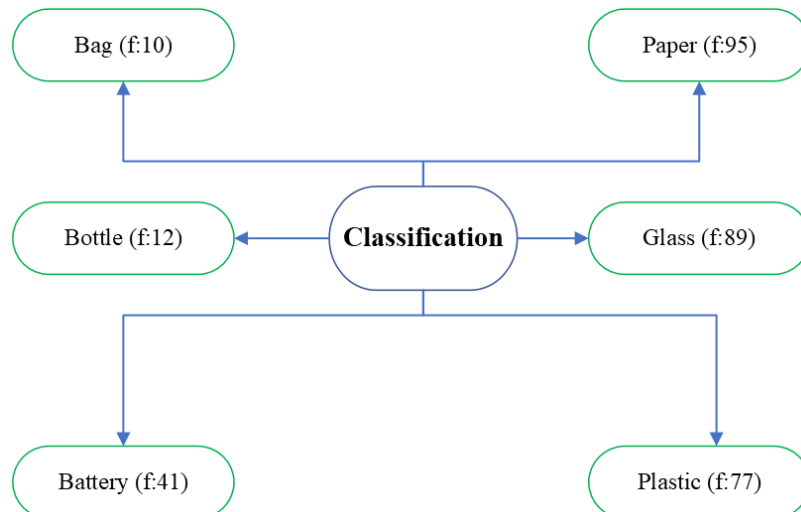


Figure 3. Students' answer word distributions regarding the "classification" category

Figure 3. Students' answer word distributions regarding the "classification" category In Figure 3, it has been determined that the answer words given by primary school students to the "Classification" category are seven and the frequency is 355. In this category, Paper (95) ranks first among the associations made by primary school students. Glass (89), plastic (77), Batterys (41), Waste (31), Bottle (12) and Bag (10) come next. In the "Classification" category; Paper, Metal, Glass, Plastic, Composite etc. are available. All the answers in the "Classification" category are thought to be related to the concept of "Recycling.".

- We should throw materials such as paper, metal and glass into recycling bins. (F, 37.S)
- My friend threw a battery in the recycling bin. (M, 62. S)
- Let's separate our garbage and throw it in the recycling bins. (M, 90. S)

- Recycling is vital for all of us. Because we use nature as plastic, glass, battery, paper, etc. separates things. Reuses products for another purpose. (F,91. S) In the "Classification" category of the key concept, when the sentences formed by primary school students are evaluated in terms of recycling, it is seen that this action is vital and its effect on gaining behavior comes to the fore.

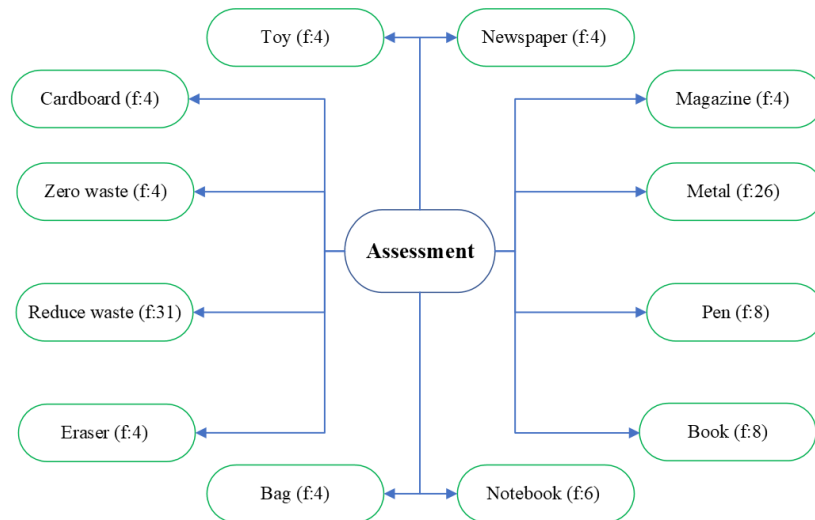


Figure 4. Response Word Distributions of Primary School Students for the "Assessment" Category

Figure 4. Response Word Distributions of Primary School Students for the "Assessment" Category in Figure 4., it is determined that the answer words given by primary school students in the "Assessment" category were 13 and the frequency was 97. In this category, Metal (26) ranks first in associations made by primary school students. After that Recycle (16), Pen (8), Book (8), Notebook (6), Reduce waste (5), Bag (4), Zero waste (4), Eraser (4), Cardboard (4), Toy (4), Newspaper (4), Magazine (4) comes. In the "Assessment" category; returning to the economy as a raw material after going through physical and chemical processes in the recycling facility, etc. are available. All the answers in the "Assessment" category are thought to be related to the concept of "Recycling.". Sentences were made for the issue;

- Recycling is the renewal of old glass, plastic and paper. (M, 53.S)
- Recycling reminds me of saving. (F, 95. S)
- In my opinion, recycling means reclaiming recyclable waste. (F, 100. S)
- An item becomes reusable. (F, 115. S) In the "Evaluation" category related to the key concept, the sentences formed by primary school students were reused when evaluated in terms of recycling, emphasizing saving.

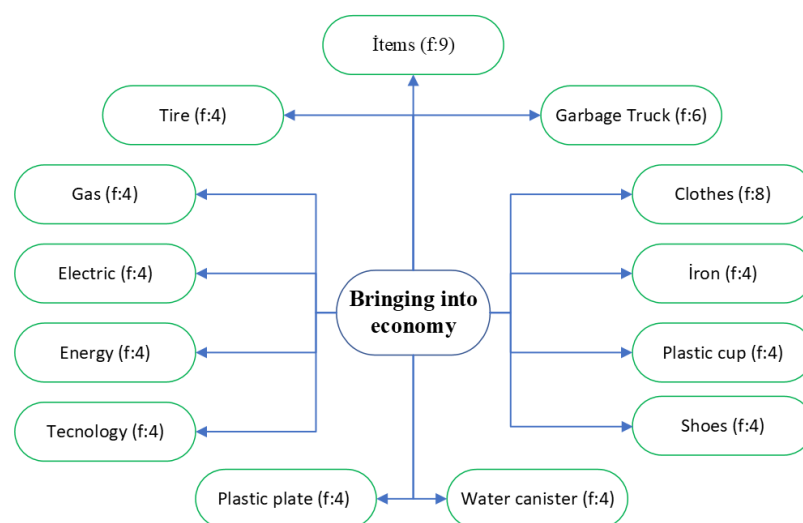


Figure 5. Response word distributions of primary school students for the category of "bringing in new product to the economy"

In Figure 5, it is determined that the answer words given by primary school students in the category of "Bringing in a New Product to the Economy" were 13 and the frequency was 63. In this category, the items (9) are in the first place in the associations made by primary school students. After that Clothes (8), Garbage Truck (6), Iron (4), Plastic cup (4), Shoes (4), Tecnology (4),

Plastic plate (4), Water canister (4), Energy (4), Electric (4), Gas (4) and Tire (4) come. In the category of "Bringing in a New Product to the Economy"; it is used in the production of a new product and there is new life-giving. All the answers in the category of "Bringing in a New Product to the Economy" are thought to be related to the concept of "Recycling.". Sentences were made for the issue;

- One day while walking on the road, I saw a man throwing paper in the trash and I was upset. (M, 43. S)
- In recycling, products are renewed for reuse. (M, 85. S)
- Instead of throwing away all products, we can recycle them and contribute to the economy. (F, 86. S)
- Recycling is to evaluate the unused item for me. (M, 98. S)

When the sentences formed by primary school students are evaluated in terms of recycling in the category of "Bringing in New Product to the economy" related to the key concept, it is seen that the emphasis is on bringing the waste materials into the economy after they are processed.

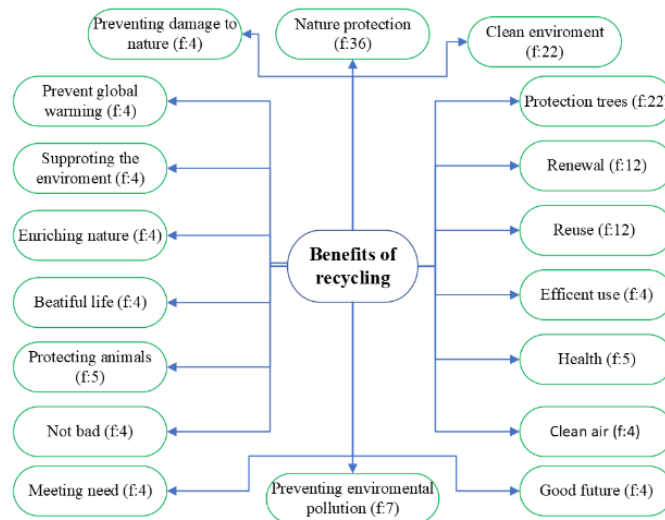


Figure 6. Response word distributions of primary school students regarding the "benefits of recycling" category

Figure 6. Response word distributions of primary school students regarding the "benefits of recycling" category In Figure 6, it is determined that the answer words given by primary school students to the "Benefits of recycling" category are 21 and their frequency is 159. In this category, nature protection (36) is in the first place among the associations made by primary school students. After that Clean environment (22) and Protecting trees (22), Renewal (12) and Reuse (12), Preventing environmental pollution (7), Health (5) and Protecting animals (5), Beautiful life (4), Enriching nature (4), Doing new things (4), Prevent global warming (4), Clean air (4), Good future (4), Meeting needs (4), Thrift (4), Not bad (4), Supporting the environment (4), Efficient use (4), Not wasting (4), Preventing damage to nature (4) comes. All the answers in the "Benefits of recycling" category are thought to be related to the concept of "Recycling.". Sentences were made for the issue;

- Let's not throw our garbage into nature. (M,9.S)
- Love nature and convert waste. (M, 19. S)
- Recycling contributes to our world. (F,40.S)
- Recycle, does not pollute the environment. (M, 47. S)

In the category of "benefits of recycling" related to the key concept, when the sentences formed by primary school students are evaluated in terms of recycling, statements about environmental protection come to the fore. Scientific, Non-Scientific and Misconception Statements in the Sentences of Primary School Students Regarding the Key Concept of "Recycling" The sentences formed by primary school students on the key concept of "Recycling" were examined and categorized. The analysed sentences were categorized as scientific, non-scientific and misconceptions developed (Ercan et al., 2010).

Table 1. Scientific, non-scientific and misconception expression frequencies in the sentences of primary school students regarding the key concept of "recycling"

Key Concept	Number of Sentences Containing Scientific Information	Number of Sentences Containing Non-scientific and Superficial Information	Number of Sentences Containing Misconceptions	Empty
Recycling	44	50	33	23

In Table 1, it was seen that primary school students could not form a meaningful sentence containing key concepts, with a high number of sentences containing non-scientific and superficial information, misconceptions and sentences left blank. Failure to

construct a meaningful sentence containing the key concept and leaving it blank is a finding that shows that students cannot learn this concept meaningfully and at a conceptual level (Ercan et al., 2010).

Table 2. Examples of related sentences made by primary school students regarding the concept of recycling

Key Concept	Sentences Containing Scientific Information	Sentences Containing Unscientific or Superficial Information	Sentences Containing Misconceptions
Recycling	• Let's throw garbage in the trash, not the environment • Recycling is important. Glass should be recycled. • Paper, glass, metal are recycled. • Recycling helps reduce waste. • We can contribute to the economy by recycling all products instead of throwing them away. • Let's not throw plastic, glass, paper in normal garbage. We have different kinds of trash bin, let's use them	• Recycling is an exquisite thing. • I think we should recycle old items and items that don't serve us well. And recycling happens. • Today we recycled. • Recycling reminds me of nature. • Recycling is everyone's right. • Recycling makes people happy.	• Everything is recyclable. • 1 ton of paper recycled 54 trees. • Recycling means returning used items to me. • Evaluate unused materials for recycling. • Recycling for me is going somewhere and restoring. • think recycling is renewing old ones.

In Table 2, it is seen that in some sample sentences formed by the students regarding the concept of "recycling", they wrote non-scientific sentences containing superficial information or misconceptions. In this case, it can be said that students have misconceptions in their cognitive structures.

DISCUSSION AND CONCLUSION

In the study conducted to determine the cognitive structures of the primary school fourth-grade students regarding the concept of recycling through WAT, the answers obtained were analysed in depth with the analysis method and collected in 5 categories. Cognitive structure associations are sufficient for the categories and the answer words collected from the students in the category fields and the concept of "recycling".

713 answers were produced under all categories for the recycling concept of students, and 59 different concepts were produced in five categories consisting of words. While the most concepts were produced in the "benefits of recycling" category (21) the answer words were protecting nature (36), clean environment and protecting trees (22), although the concepts produced in the "classification" category (7) were less, the most given answer words were Paper (95), Glass (89), Plastic (77), Battery (41), Waste (31), Bottle (12) and Bag (10). According to the results of the study, the two different "Assessment" (13) and "Bringing in New Product to the Economy" (13) categories are the two most associated with the concept of recycling. Among these categories, the most repeated of the answer words associated with the "assessment" category were metal (96), recycling (16) book and pen (8), while the most repeated answer words associated with the category of "Bringing in New Product to the Economy" were goods (9), clothes (8) and garbage truck (6).

In the study, the category of "Separate Collection from the Source"(5) is the least associated with the recycling concept of the students. In this category, the most repetitive ones in the answers of the students; the concepts of recycling bin (14), factory (8), tin (7), trash (6), metal boxes (4) are coming. They gave importance to the use of recycling bins because of the separate collection of the students at the source in recycling. Katircioğlu (2019) and Yılmaz et al., (2020), found in their research that the high level of general environmental knowledge of individuals depends on their knowledge about recycling.

According to the results obtained in the study, the number of words that primary school students associated with concepts related to recycling was high. The criterion used to determine whether the concept is understood is the number and quality of words associated with that concept. The words associated with the concept depend on a good understanding of the concept (Özatlı et al., 2015). Simultaneously, it can be argued that the meaning of the concept increases as the word is associated, and a concept that is not associated with any word is meaningless (Akyurt, 2020; Doğan et al., 2018; Ercan et al., 2010; Kaya & Taşdere, 2016; Robles, 2015). The more words students can associate with a concept, the more meaningfully they can learn the concept.

In the study, it is seen that the concept of "recycling" forms meaningful sentences at the word level and sentences contain some misconceptions at the sentence level. Concept errors such as everything can be recycled, unused items can be recycled, and the old ones are renewed, were identified in the sentences they formed regarding the concept of "recycling". Işıklı (2011) determined that the related concepts were not correctly expressed in the related sentences formed for the key concepts in the study in which they carried out the cognitive structures of the pre-service teachers for Atatürk's principles by applying the WAT. In the studies of Ercan, et al. (2010) "observing cognitive structure and conceptual change through the word association test", some misconceptions were identified by looking at the quality of the associated concepts and words. Kaya (2015) and Onat & Keskin (2019) found meaningful associations at the word level in the word association test applied by geography students regarding the key concept of air but encountered misconceptions in sentence examples. As seen in the studies, it was understood that it was effective to make sentences for the related concept and to determine the misconceptions.

From this perspective, students organize their cognitive structures for the concept of recycling meaningfully and learn the concepts. In line with the results obtained in the study; The subject of recycling should be expanded or presented as a separate

course in environmental issues in the Life Science, Science and Social Studies course in primary school programs. Collaborating with surrounding institutions and organizations to inform students and increase their awareness; it should be ensured that measures are taken for the storage, separation, reuse of wastes. This study should start from schools and spread to the environment with the multiplier effect.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, author-ship, and/or publication of this article.

Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

Ethics committee approval was obtained from Manisa Celal Bayar University Social and Human Sciences Scientific Research and Publication Ethics Committee with the approval number 050.01.04 on 2 February 2020.

REFERENCES

- Akyurt, H. (2020). Turizm lisans öğrencilerinin kelime ilişkilendirme testi yöntemi ile turizm eğitimi algılamalarının ölçülmesi: Giresun Üniversitesi örneği. *Türk Turizm Araştırmaları Dergisi*, 3 (3), 759–774. <https://doi.org/10.26677/TR1010.2019.190>
- Allen, M. (2019). *Misconceptions in primary science* (3rd ed.). McGraw-Hill Education.
- Altıkolatsi, E., Karasmanaki, E., Parissi, A., & Tsantopoulos, G. (2021). Exploring the factors affecting the recycling behavior of primary school students. *World*, 2 (3), 334–350. <https://doi.org/10.3390/world2030021>
- Bahl, S., Milne, G. R., Ross, S. M., Mick, D. G., Grier, S. A., Chugani, S. K., ... & Boesen-Mariani, S. (2016). Mindfulness: Its transformative potential for consumer, societal and environmental well-being. *Journal of Public Policy & Marketing*, 35 (2), 198–210. <https://doi.org/10.1509/jppm.15.139>
- Bjorklund, D. F., & Causey, K. B. (2017). *Children's thinking: Cognitive development and individual differences*. Sage Publications.
- Boca, G. D., & Saraçlı, S. (2019). Environmental education and student's perception, for sustainability. *Sustainability*, 11 (6), 1553. <https://doi.org/10.3390/su11061553>
- Bryman, A. (2016). *Social research methods* (5th ed.). Oxford University Press.
- Büyüksaatçi, S., Küçükdeniz, T., & Esnaf, Ş. (2008). Geri dönüşüm tesislerinin yerinin Gustafson-Kessel Algoritması-Konveks programlama melez modeli tabanlı simülasyon ile belirlenmesi. *İstanbul Ticaret Üniversitesi Fen Bilimleri Dergisi*, 7 (13), 1–20. <https://dergipark.org.tr/tr/pub/ticaretfbd/issue/21353/229061>
- Creswell, J. W. (2020). *Nitel araştırma yöntemleri: Beş yaklaşıma göre nitel araştırma ve araştırma deseni* (M. Bütün & S. B. Demir, Trans.; 5th ed.). Siyasal Kitabevi.
- Doğan, S., Yücel Güngör, M., & Güngör, O. (2018). Turizm meslek yüksekokulu öğrencilerinin sosyal medyaya yönelik bilişsel yapılarının kelime ilişkilendirme testi aracılığıyla incelenmesi. *Turizm Akademik Dergisi*, 5 (1), 166–176. <https://doi.org/10.21325/jotags.2017.124>
- Edgell Sr, D. L. (2016). *Managing sustainable tourism: A legacy for the future*. Routledge.
- Ekiz, D. (2009). *Bilimsel araştırma yöntemleri*. Anı Yayıncılık.
- Ercan, F., Taşdere, A., & Ercan, N. (2010). Kelime ilişkilendirme testi aracılığıyla bilişsel yapının ve kavramsal değişimin gözlenmesi. *Türk Fen Eğitimi Dergisi*, 7 (2), 136–154. <http://tused.org/index.php/tused/article/view/515/443>
- Erol, A. (2016). *Proje yaklaşımına dayanan aile katılımlı çevre eğitimi programının 5-6 yaş çocuklarının çevreye yönelik farkındalık ve tutumlarına etkisinin incelenmesi* (Unpublished master's thesis). Pamukkale Üniversitesi Eğitim Bilimleri Enstitüsü.
- Friedman, N. P., & Miyake, A. (2017). Unity and diversity of executive functions: Individual differences as a window on cognitive structure. *Cortex*, 86, 186–204. <https://doi.org/10.1016/j.cortex.2016.04.023>
- Güneş, G. (2018). Okul öncesi fen ve doğa eğitimi araştırmalarına ilişkin bir tarama çalışması: Türkiye örneği. *Erken Çocukluk Çalışmaları Dergisi*, 2 (1), 33–67. <https://doi.org/10.24130/eccd-jecs.196720182150>
- Güven, S., & Yılmaz, N. (2017). Role and importance of family at preschool children environmental education. *European Journal of Sustainable Development*, 6 (4), 105. <https://doi.org/10.14207/ejsd.2017.v6n4p105>
- Hammami, M. B. A., Mohammed, E. Q., Hashem, A. M., Al-Khafaji, M. A., Alqahtani, F., Alzaabi, S., & Dash, N. (2017). Survey on awareness and attitudes of secondary school students regarding plastic pollution: Implications for environmental education

- and public health in Sharjah city, UAE. *Environmental Science and Pollution Research*, 24 (25), 20626–20633. <https://doi.org/10.1007/s11356-017-9625-x>
- Henchion, M., Hayes, M., Mullen, A. M., Fenelon, M., & Tiwari, B. (2017). Future protein supply and demand: Strategies and factors influencing a sustainable equilibrium. *Foods*, 6 (7), 53. <https://doi.org/10.3390/foods6070053>
- Işıklı, M. T. (2011). Kelime ilişkilendirme testi aracılığıyla öğretmen adaylarının Atatürk ilkelerine yönelik bilişsel yapılarının incelenmesi. *Uşak Üniversitesi Sosyal Bilimler Dergisi*, 4 (1), 50–72. <https://doi.org/10.12780/UUSB82>
- Jickling, B., & Wals, A. E. J. (2019). Globalization and environmental education: Looking beyond sustainable development. In *Curriculum and environmental education* (pp. 221–241). Routledge. <https://doi.org/10.1080/00220270701684667>
- Katircioğlu, G. (2019). *Okul dışı öğrenme ortamlarının 7. sınıf öğrencilerinin geri dönüşüm konusundaki doğa algısı ve bilinç düzeyine etkisi* (Unpublished master's thesis). Pamukkale Üniversitesi.
- Kaya, B. V. (2015). Coğrafya öğrencilerinin hava kavramlarıyla ilgili bilişsel yapılarının kelime ilişkilendirme testi ile belirlenmesi. *Turkish Studies International Periodical For The Languages Literature and History of Turkish or Turkic*, 10 (7), 554–574. <https://doi.org/10.7827/TurkishStudies.8166>
- Kaya, M. F., & Taşdere, A. (2016). İlkokul Türkçe eğitimi için alternatif bir ölçme değerlendirme tekniği: Kelime ilişkilendirme testi (KIT). *Electronic Turkish Studies*, 11 (9), 803–820. <https://doi.org/10.7827/TurkishStudies.9499>
- Keleş Ural, P., & Keleş, M. İ. (2018). İlkokul 3. ve 4. sınıf öğrencilerinin geri dönüşüm kavramı ile ilgili algıları. *Erzincan Üniversitesi Eğitim Fakültesi Dergisi*, 20 (2), 481–498. <https://doi.org/10.17556/erziefd.404816>
- Klahr, D., & Wallace, J. G. (2022). *Cognitive development: An information-processing view*. Routledge.
- MEB. (2022). Çevre eğitimi ve iklim değişikliği dersinin müfredatı tamamlandı. <https://www.meb.gov.tr/cevre-egitimi-ve-iklim-degisikligidersinin-mufredati-tamamlandi/haber/25946/tr>
- Merriam, S. B., & Grenier, R. S. (Eds.). (2019). *Qualitative research in practice: Examples for discussion and analysis*. John Wiley & Sons. <https://doi.org/10.15612/BD.2004.483>
- Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation*. Jossey-Bass.
- Muise, I., Adams, M., Côté, R., & Price, G. W. (2016). Attitudes to the recovery and recycling of agricultural plastics waste: A case study of Nova Scotia, Canada. *Resources, Conservation and Recycling*, 109, 137–145. <https://doi.org/10.1016/j.resconrec.2016.02.011>
- Onat, G., & Keskin, E. (2019). Organik gıda kavramının kelime ilişkilendirme testi aracılığıyla analizi. *Journal Of Tourism And Gastronomy Studies*, 7 (4), 3275–3289. <https://doi.org/10.21325/jotags.2019.528>
- Özatlı, N. S., & Bahar, M. (2016). Öğrencilerin boşaltım sistemi konusundaki bilişsel yapılarının yeni teknikler ile ortaya konması. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*, 10 (2), 9–26. <https://dergipark.org.tr/en/pub/aibuefd/issue/1499/18134>
- Patton, M. Q. (2014). *Qualitative research & evaluation methods: Integrating theory and practice* (4th ed.). Sage Publications.
- Robles, K. A. (2015). *Increasing recycling in elementary school classrooms using interdependent group-oriented contingencies* (Doctoral dissertation). California State University, Fresno.
- Saraç, H. (2017). Türkiye'de okul dışı öğrenme ortamlarına ilişkin yapılan araştırmalar: İçerik analizi çalışması. *Eğitim Kuram ve Uygulama Araştırmaları Dergisi*, 3 (2), 60–81. <https://dergipark.org.tr/en/pub/ekud/issue/29425/337191>
- Stiles, J., Brown, T. T., Haist, F., & Jernigan, T. L. (2015). Brain and cognitive development. *Handbook of child psychology and developmental science*, 1–54. <https://doi.org/10.1002/9781118963418.childpsy202>
- Timur, B., İmer Çetin, N., Timur, S., & Aslan, O. (2020). Kelime ilişkilendirme testi ile fen bilgisi öğretmenlerinin bilimin doğasına ilişkin sahip oldukları kavramların incelenmesi. *Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi*, 40 (1), 113–137. <https://doi.org/10.17152/gefad.600942>
- UNESCO. (1992). *Agenda 21 – Report of the United Nations Conference on Environment and Development*. Chapter 36 'Promoting education, public awareness and training'. Rio de Janeiro.
- Wichaisri, S., & Sopadang, A. (2018). Trends and future directions in sustainable development. *Sustainable Development*, 26 (1), 1–17. <https://doi.org/10.1002/sd.1687>
- Yıldırım, A., & Şimşek, H. (2021). *Sosyal bilimlerde nitel araştırma yöntemleri*. Seçkin Yayıncılık.
- Yılmaz, S., Bolat, E. Y., & Gölcük, İ. (2020). Erken çocukluk döneminde uygulanan çevre eğitim programının çocukların çevreye karşı tutumları üzerindeki etkisi. *Van Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi*, 17 (1), 557–578. <https://doi.org/10.33711/yyuefd.693833>
- Yılmaz, A., Çelikler, D., & Aksan, Z. (2020). Waste separation in primary education - a pre-post design study to capture students' awareness of recycling with cartoons. *CHEMKON*, 28 (3), 103–111. <https://doi.org/10.1002/ckon.201900052>



| Research Article / Araştırma Makalesi |

Use of Metacognitive Strategies in Studies on Maqam-based Piano Pieces

Makamsal Piyano Eserlerine Yönelik Çalışmalarda Üstbilişsel Stratejilerin Kullanımı¹

Ece TUNCER TÜFEKÇİ², Aytekin ALBUZ³

Keywords

1. Piano education
2. Maqam-based piece studies
3. Metacognitive strategies
4. Metacognitive awareness
5. Study diaries

Anahtar Kelimeler

1. Piyano eğitimi
2. Makamsal eser çalışmaları
3. Üstbilişsel stratejiler
4. Üstbilişsel farkındalık
5. Çalışma günlükleri

Received/Başvuru Tarihi
29.01.2025

Accepted / Kabul Tarihi
25.07.2025

Abstract

Purpose: The aim of this study is to examine the effect of using metacognitive strategies in piano education on metacognitive awareness and piano performance. In addition, it was aimed to reveal the metacognitive knowledge and metacognitive regulation skills used by the students in the process of studying maqam-based pieces.

Design/Methodology/Approach: The research was conducted within the scope of mixed method. The quantitative dimension of the study used a one-group pretest-posttest experimental design. In the experimental process, individual piano lessons were held with the study group students (N=8) for 9 weeks, and the process of studying maqam-based pieces was carried out using metacognitive strategies. Quantitative data were obtained through the Metacognitive Awareness Inventory (MAI) and Piano Performance Rubric for Maqam-based Pieces (PPRMP). Within the qualitative dimension, the piece study diaries kept by the study group during the experimental process were analyzed.

Findings: It was determined that the use of metacognitive strategies in the process of studying maqam-based pieces made a significant difference in the metacognitive awareness levels and piano performance levels of the study group. In the piece study diaries, many expressions were found in which students reflected their metacognitive knowledge and skills about their learning processes and piano performances. It was determined that students mostly used metacognitive monitoring and evaluation skills in the experimental process.

Highlights: Although the metacognitive awareness of the study group regarding the knowledge of cognition dimension was higher than the regulation of cognition, it was determined that the activities related to the regulation of cognition were reflected more in the piece study diaries. Since piano education is an applied field, students' use of metacognitive editing skills and their frequent reflection of editing activities in their diaries are compatible with the structure of the process.

Öz

Çalışmanın amacı: Bu çalışmanın amacı, piyano eğitiminde üstbilişsel stratejilerin kullanımının üstbilişsel farkındalık ve piyano performansı üzerindeki etkisini incelemektir. Bununla birlikte öğrencilerin makamsal eser çalışma sürecinde kullandıkları üstbilişsel bilgilerinin ve üstbilişsel düzenleme becerilerinin ortaya çıkarılması amaçlanmıştır.

Materyal ve Yöntem: Araştırma karma yöntem kapsamında yürütülmüştür. Çalışmanın nicel boyutunda tek grup ön test-son test deneysel desen kullanılmıştır. Deneysel süreçte çalışma grubu öğrencileri (N=8) ile 9 hafta boyunca bireysel piyano dersi yapılmış ve üstbilişsel stratejiler kullanılarak makamsal eser çalışma süreci gerçekleştirilmiştir. Nicel veriler Bilişötesi Farkındalık Envanteri (BFE) ve Makamsal Eserlere Yönelik Piyano Performans Rubriği (MEYPPR) aracılığıyla elde edilmiştir. Nitel boyut kapsamında çalışma grubunun deneysel süreç boyunca tutmuş olduğu eser çalışma günlükleri incelenmiştir.

Bulgular: Makamsal eser çalışma sürecinde üstbilişsel strateji kullanımının çalışma grubunun üstbilişsel farkındalık düzeyleri ve piyano performans düzeyleri üzerinde anlamlı bir fark oluşturduğu tespit edilmiştir. Eser çalışma günlüklerinde öğrencilerin öğrenme süreçlerine ve piyano performanslarına yönelik üstbilişsel bilgi ve becerilerini yansıttıkları birçok ifadeye rastlanmıştır. Öğrencilerin deneysel süreçte en fazla üstbilişsel izleme ve değerlendirme becerilerini kullandıkları belirlenmiştir.

Önemli Vurgular: Çalışma grubunun bilişin bilgisi boyutuna ilişkin üstbilişsel farkındalıklarının bilişin düzenlenmesine göre daha yüksek olmasına rağmen eser çalışma günlüklerinde bilişin düzenlenmesine ilişkin faaliyetlerin daha çok yansıtıldığı tespit edilmiştir. Piyano eğitiminin uygulamalı bir alan olması nedeniyle öğrencilerin üstbilişsel düzenleme becerilerini kullanmaları ve düzenleme faaliyetlerini günlüklere sıklıkla yansıtmış olmaları sürecin yapısı ile uyumludur.

¹ This study is based on the doctoral dissertation of the first author under the supervision of the second author.

² **Corresponded Author**, Kastamonu University, Faculty of Education, Department of Music Education, Kastamonu, Türkiye; <https://orcid.org/0000-0002-0773-4045>

³ Gazi University, Gazi Faculty of Education, Department of Music Education, Ankara, Türkiye; <https://orcid.org/0000-0001-7919-0596>

INTRODUCTION

Within today's contemporary education approach, rather than teaching knowledge and skills through a superficial transfer, it is necessary to provide students with an awareness of their thinking skills and to manage their learning processes. In this context, in the education process, students are expected to approach knowledge critically and constantly question their learning situations rather than learning knowledge directly through memorization. To meet these expectations, students must recognize and organize their learning processes using planning, monitoring, and evaluation skills. The concept of metacognition, which has been the subject of many studies in educational psychology and learning, is related to individuals' taking an active role in their learning by following their learning stages, in other words, their cognitive processes.

Metacognition includes the knowledge of individuals in line with their awareness of their cognitive processes and their ability to monitor, control, organize, and evaluate those processes (Jacobs & Paris, 1987; Wilson, 1999; Papaleontiou-louca, 2003). The concept of metacognition, which was first used by Flavell in 1976, refers to the active monitoring of information processing processes that occur through the cognitive interactions of the individual with the environment. This monitoring process usually takes place in line with specific goals and objectives. Metacognition also encompasses the regulation and organization of these processes, depending on the information obtained from monitoring (Flavell, 1976). Thus, the relationship between cognition and metacognition can be understood by defining cognitive skills as "worker" and metacognitive skills as "boss." While cognitive skills include recording, inferring, comparing, and analyzing information, metacognitive skills include executive/controlling processes such as planning, monitoring, and evaluation (Hartman, 1997).

Researchers have created various models of metacognition regarding the structure of metacognition and its components (Brown, 1987; Flavell, 1979; Jacobs & Paris, 1987; Paris & Winograd, 1990; Pintrich et al., 2000; Schraw & Dennison, 1994; Tobias & Everson, 2002). In Flavell's (1979) metacognition model, which is one of the first models created to understand the structure of metacognition, there are four essential components: "metacognitive knowledge," "metacognitive experiences," "goals (or tasks)," "actions (or strategies)." Metacognitive knowledge refers to an individual's knowledge about cognitive tasks, goals, and experiences. This component includes the dimensions of "person knowledge," "task knowledge," and "strategy knowledge." Metacognitive experiences are cognitive or affective experiences that occur before, after, or during a cognitive task. Metacognitive goals reflect the goals set to accomplish a cognitive task; metacognitive actions reflect the strategies used to achieve the goals (Flavell, 1979). Among other metacognition models, Jacobs and Paris's (1987) metacognition model includes two dimensions, namely "self-evaluation of cognition" and "self-management of thinking," while the model of Pintrich et al. (2000) emphasizes the relationship between metacognition and self-regulation with the dimensions of "metacognitive knowledge," "metacognitive judgments and monitoring," "self-regulation and control." As can be understood from the metacognition models briefly described above, there are different perspectives on metacognition and its structure. In addition to these different models, the most accepted approach to metacognition in the literature is that metacognition consists of two essential components: "knowledge of cognition" and "regulation of cognition" (Baker & Brown, 1980; Brown, 1987; Schraw & Dennison, 1994).

Knowledge of cognition is defined as individuals' knowledge of the learning process and learning skills. Knowledge of cognition consists of three sub-dimensions: Declarative, procedural, and conditional knowledge. Declarative knowledge includes the individual's knowledge about their strengths and weaknesses in learning skills; procedural knowledge includes the knowledge about how to perform a learning task and which learning strategies should be used; and conditional knowledge includes the knowledge about when and why learning strategies should be used (Schraw & Dennison, 1994; Schraw & Moshman, 1995). To explain the structures related to the sub-dimensions of knowledge of cognition in the context of music education and instrument education, a student knows that they have deficiencies in reading the notes and expressing that they cannot pay enough attention to the nuances when they cannot read the notes can be shown as an example of the student's declarative knowledge. Knowing which strategies to use and how to use strategies to practice a new etude (for example, working at a slow tempo, dividing the piece into sections, rhythmic reading, etc.) represents procedural knowledge; knowing which practice strategies to apply in the face of situations such as the period in which the piece was composed, the characteristics it contains, and its difficulty level represents conditional knowledge.

Regulation of cognition, another essential component of metacognition, includes metacognitive activities that enable the individual to control the learning process. This component consists of five sub-dimensions: Planning, monitoring, evaluation, debugging, and information management. Planning involves setting goals and strategies for completing the task before starting to learn it. Metacognitive monitoring is when individuals follow themselves and their learning situation with awareness during the learning process, and metacognitive evaluation is when individuals analyze their learning performance after the task. While debugging involves the use of strategies to eliminate the mistakes made by the individual during learning, information management is the strategy used by the individual to organize the information they encounter for learning in a permanent way (Schraw & Dennison, 1994). In this context, a student's preliminary preparations, such as selecting the necessary technical exercises, preparing a study plan, and setting general or specific goals by considering the piece to be learned within the scope of instrument studies, can be shown as an example of planning. It is a sign of metacognitive monitoring when the student follows whether they play the piece at a constant tempo during the performance and whether they apply the nuances in the piece as they should. After the performance is completed, analyzing the adequacies and inadequacies and reflecting on the strategies' effect reflect metacognitive evaluation. The student's thinking and applying different solutions to eliminate their mistake in playing

different rhythmic patterns indicates that they use debugging strategies, visualizing the expression elements (cantabile, dolce, scherzando, etc.) that they need to apply by marking them with different colored pencils is an example of information management strategies.

All dimensions of metacognition support music education students' content knowledge, technical skills, and musical development. Especially in instrument performance, the use of psychomotor skills comes to the fore. In addition, for these skills to develop correctly, students must have sufficient knowledge and comprehension of the exercises, etudes, or pieces studied. This complex activity of music performance requires critical thinking skills and metacognitive awareness (Machfauzia et al., 2020). Metacognitive skills can develop spontaneously during musical experiences. On the other hand, practices aimed at revealing awareness of metacognition in learning environments and supporting metacognitive thinking during learning tasks are necessary. These practices include using metacognitive strategies that guide students to understand their learning processes and enable them to realize their thoughts and practices aligned with their thoughts during the learning process. Benton (2013) stated the importance and necessity for teachers to direct students to use metacognitive strategies such as reflecting on learning, making self-evaluations for improvement, and participating in a think-aloud session. In addition, metacognitive strategies such as planning, monitoring, evaluating, identifying difficulties, thinking aloud, identifying what you know and what you do not know, deep thinking questions, modeling, and journaling are suggested to be used in learning environments by different researchers to develop metacognitive knowledge, metacognitive skills and thus awareness of them (Blakey & Spance, 1990; Costa, 1984; Papaleontiou-louca, 2003). Reflective journals, in which students share their observations about their learning processes, are tools used in research to develop and assess metacognition (Fleur et al., 2021). Besides, these materials, such as strategy evaluation matrix and regulatory checklists, are useful tools for developing metacognitive knowledge and metacognitive regulation (Schraw, 1998).

Many studies have been conducted on metacognition and metacognitive strategies in general and vocational music education. The topics addressed in these studies include determining the metacognitive strategies used by students within the scope of instrument education (Güven & Kılıç, 2021), determining the level of use of metacognitive strategies by prospective music teachers (Deniz, 2015), examining the development of the experimental process on metacognitive awareness (H. Yokuş, 2010; Sakarya & Şendurur, 2020; Kaplan & Aykut, 2022) and examining the effect of developing metacognition on performance in instrument education (T. Yokuş, 2010; Bathgate et al., 2012; Ergin & Durak, 2016; Bonnaire & González-Moreno, 2023). These studies showed that the studies conducted to develop metacognition in music education effectively improved students' metacognitive awareness and instrument performance. In addition, it is known that metacognitive skills contribute to the development of important competencies in the field of music education, such as self-confidence, independent learning, deciphering skills, listening comprehension skills, and music performance (Avcı Akbel, 2019). Therefore, high metacognitive awareness and the use of metacognitive skills in the learning process contribute to the development of students in different competence areas.

Metacognitive skills and metacognitive strategy use are observed more in expert than novice musicians (Hallam, 2001). Expert musicians follow their learning processes with awareness in line with the goals they set, are aware of the requirements for the task, organize their study time to get maximum efficiency, identify difficult passages in the piece they are studying, and select and apply appropriate strategies for them (Benton, 2014). All these behaviors are directly related to the use of metacognition. Metacognitive knowledge and skills play an important role in musicians' designing, monitoring, evaluating, and, when necessary, modifying and improving their instrumental studies in line with specific performance goals (Concina, 2019). In this direction, it is thought that ensuring that the metacognitive behaviors seen in expert musicians are performed by students receiving instrument training will increase the success of students' instrument performance. In piano education, supporting students to use metacognitive strategies in the learning process and enabling them to carry out the study process with metacognitive awareness is predicted to contribute to both the development of students' self-learning skills and the highest level of efficiency from piano education.

This study aimed to examine the effect of metacognitive strategies on students' metacognitive awareness and piano performance levels and to determine the metacognitive knowledge and skills used by students during the study process. In line with this purpose, answers to the following questions were sought:

1. Is there any difference between the metacognitive awareness scores of the study group before and after the experimental process?
2. Is there any difference between the piano performance scores of the study group before and after the experimental process?
3. How is the study group's use of metacognition during the experimental process reflected in the piece study diaries?

METHOD/MATERIALS

Research Design

The research was conducted using a mixed method in which quantitative and qualitative data collection methods were used together; it was carried out in line with the convergent parallel design, one of the mixed method designs. In the convergent parallel design, qualitative and quantitative data collected simultaneously in the research process are analyzed separately and combined at the interpretation stage. This design enables the problem addressed in the research to be examined from different perspectives

by using quantitative and qualitative data types together (Creswell & Plano Clark, 2020). In this context, using the convergent parallel design in the study was aimed at complementing the data on quantitative and qualitative dimensions and examining the research problem from a broader perspective.

In the quantitative dimension of the study, "one-group pretest-posttest experimental design" was used to determine whether the process of studying maqam-based pieces in which metacognitive strategies were used created a significant difference in students' metacognitive awareness levels and piano performance levels. In the experimental process, individual piano lessons were conducted with each student in the study group for 45 minutes per week through 9 weeks. During the individual lessons, specific metacognitive strategies were used, and the "process of studying maqam-based pieces" was carried out using maqam-based pieces composed by the researcher. In the pretest and posttest phases, students' metacognitive awareness levels and piano performance levels were evaluated through quantitative measurement tools. In the qualitative dimension of the study, the piece study diaries kept by the study group students during the process of studying maqam-based pieces were analyzed to determine the metacognitive knowledge and skills of the students that emerged during the study process.

Study Group

The study group of the research consists of 8 students studying at Kastamonu University Faculty of Education, Department of Fine Arts Education, Division of Music Education, same university's Institute of Social Sciences, Department of Fine Arts Education, Music Education Program in the spring semester of the 2022-2023 academic year.

Initially, considering that the performance levels of the study group students should be at an average level, the piano performances of eleven students who had received piano training were evaluated through the Piano Performance Rubric for Maqam-based Pieces (PPRMP). All eleven evaluated students scored above the average score (62.5) that can be obtained from the PPRMP. After the preliminary evaluation, three students reported that they could not participate in the face-to-face experimental process due to the decision of the Council of Higher Education (YÖK) to switch to distance education for the spring semester of the 2022-2023 academic year. For this reason, the experimental process was carried out with the participation of eight students. All the study group students (N=8) are female, and the group consists of four undergraduate and four graduate students.

Data Collection Tools

In this study, the Metacognitive Awareness Inventory (MAI) and Piano Performance Rubric for Maqam-based Pieces (PPRMP) were used to obtain data related to the quantitative dimension. The data relating to the qualitative dimension of the study were obtained through Piece Study Diaries.

Metacognitive Awareness Inventory (MAI)

In the pretest and posttest stages of the study, the MAI was used to measure the metacognitive awareness levels of the students. The MAI was developed by Schraw and Dennison (1994) to determine the awareness levels of individuals regarding their metacognition. The inventory was adapted into Turkish by Akin et al. (2007). The inventory is a 5-point Likert-type measurement tool consisting of 52 items. According to the results of exploratory factor analysis, the inventory consists of two main components, namely knowledge of cognition and regulation of cognition, and a total of eight subcomponents. The sub-components of knowledge of cognition are "declarative knowledge," "procedural knowledge," and "conditional knowledge;" the sub-components of regulation of cognition are "planning," "monitoring," "evaluation," "debugging," and "information management." The Cronbach's alpha reliability coefficient for the whole inventory is .95 (Akin et al., 2007). Within the scope of this study, the internal consistency coefficient of the MAI was reanalyzed with a pilot study conducted with 51 students studying in the music teaching program before the experimental process, and the reliability coefficient was calculated as .95, similar to the results obtained from the Turkish form.

The minimum score that can be obtained from the MAI is 52, and the maximum score is 260. To interpret the metacognitive awareness levels, raw scores are divided by the number of items, and transformed scores are obtained. Accordingly, 2.5 points and above are considered high metacognitive awareness, and 2.5 points and below are considered low metacognitive awareness (Akin et al., 2007).

Piano Performance Rubric for Maqam-based Pieces (PPRMP)

In the pretest and posttest stages of the study, the PPRMP prepared by the researcher was used to determine the piano performance levels of the students. Before the PPRMP was prepared, the measurement tools developed to evaluate piano performance in the literature were examined (Grançer Okay, 2010; Kaynak, 2011; Minez, 2012; Tunç, 2016; Turgut & Dalkıran, 2021), and a new measurement tool suitable for the purpose of the research was needed. Accordingly, a rubric consisting of three dimensions, namely "knowledge dimension," "technical dimension," and "musical expression dimension," and 25 items were prepared. In the development phase of the rubric, content validity and Cronbach's alpha reliability coefficient were examined. The knowledge dimension consists of 6 items, the technical dimension consists of 14 items, and the musical expression dimension consists of 5 items.

The content validity of the rubric items and the entire rubric was examined using the Lawshe technique as a result of the evaluation of nine instructors who are experts in the field of piano education. Accordingly, since the content validity index value

(0.94) calculated for the entire rubric was greater than the minimum value (0.778) determined according to the number of experts, it was determined that the content validity of the rubric items was significant (Yeşilyurt & Çapraz, 2018). Cronbach's alpha reliability coefficients for the reliability of the rubric were calculated as .72, .63, and .70 for the knowledge, technical, and musical expression dimensions, respectively. At the same time, the reliability coefficient for the whole rubric was .80. According to the results obtained, it was determined that the rubric had a good level of reliability ($\alpha=.80$).

PPRMP is a 5-point Likert scale, and the performance levels are "completely correct/fully adequate (5)," "largely correct/largely adequate (4)," "partially correct/partially adequate (3)," "largely incorrect/largely inadequate (2)," "completely incorrect/fully inadequate (1)". The minimum score that can be obtained from PPRMP is 25, and the maximum score is 125. To interpret the piano performance levels, raw scores are divided by the number of items, and transformed scores are obtained. The score levels created for the evaluation of the transformed scores obtained through PPRMP were determined as follows: Very low-performance level (1.00-1.80), low-performance level (1.81-2.60), medium performance level (2.61-3.40), high-performance level (3.41-4.20), very high-performance level (4.21-5.00).

Piece Study Diaries

The piece study diaries, from which the study's qualitative data were obtained, are the diaries in which the study group students conveyed their feelings and thoughts about all the studies in the process of studying maqam-based pieces. The diaries were kept after each piano lesson, except for the last week of the study period and at the end of an individual practice session during the week. Thus, when the experimental study was completed, a total of 128 diaries, 16 from each student, were obtained.

Data Collection Process

The experimental process of the research is based on the use of metacognitive strategies in the process of studying maqam-based pieces. In this direction, the pieces to be studied and the stages of the study process were determined.

In the experimental process, it would be appropriate to work on pieces that had not been encountered before in terms of students gaining new learning experiences and equal opportunities for everyone. From this point of view, the researcher composed four pieces in Hüseyni, Hicaz, Segah and Kürdi maqams to be used in the research. The pieces were written within the framework of the "quartet harmonic approach," "quartet harmonic and contrapuntal approach," and "harmonic and contrapuntal mixed approach" (Albuz, 2020) from Turkish music polyphony approaches. Expert opinions were consulted on the accuracy of the polyphony approaches used in the study and the suitability of their difficulty levels to the study process. The necessary arrangements were made in line with the opinions.

To determine the piano pieces to be performed by the students in the pretest and posttest, a piece pool consisting of nine maqam-based pieces used in piano education, compatible with the maqams of the pieces to be studied in the experimental process, was created. The created piece pool was presented to four experts in piano education. In line with the expert evaluations, "Sarı Zeybek" from Tuğcular's (2017) book "Piyano Albümü: Anadolu Ezgileri" was used in the pretest, and "Segah" from Tuğcular's (2003) book "Türkünün Rengi: Piyano için 23 Parça" was used in the posttest. In the pretest and posttest stages of the experimental process, the piano performances of the students for the related pieces were video recorded to be evaluated with PPRMP. Then, the students answered MAI.

The process of studying maqam-based pieces was carried out in 5 stages for each piece, considering the preliminary works, the work to be done on the piece, and the time planning of the experimental process. The stages are as follows:

- Stage 1: Examining the maqam structure of the piece/Working on scales and cadences related to the maqam,
- Stage 2: Analyzing and deciphering the piece,
- Stage 3: Scale and cadence repetition,
- Stage 4: Studies related to the piece,
- Stage 5: Performing and completing the piece.

In the experimental process, metacognitive strategies of "planning," "monitoring," "evaluation," "identifying difficulties," "identifying what you know and what you do not know," "deep thinking questions," "thinking-aloud" and "journaling" were used to improve students' metacognitive regulation skills and increase their metacognitive awareness. Planning, monitoring, and evaluation strategies were used through the regulatory checklist prepared by the researcher according to the study process. Students answered the questions about these strategies in writing on the regulatory checklist. The planning strategy questions were about setting goals and learning strategies for studying and creating a time plan, and the questions were answered at Stage 2 before starting to study the piece. Monitoring strategy questions were about determining whether the control of posture, hand-wrist position, checking the accuracy of technique, nuance applications, monitoring performance errors, and the questions were answered in Stage 4 during the process of studying the piece. The evaluation strategy questions were about evaluating the performance process from different perspectives, and the questions were answered in Stage 5 after the completing the piece was completed.

Other metacognitive strategies were applied verbally at every stage of the study process. In the strategies of identifying difficulties and what they know and do not know, the teacher asked the students to express the problems they encountered while studying the pieces and to identify the knowledge they had about their characteristics. With deep thinking questions, the student was directed to think about issues such as determining the preliminary work for the piece and identifying the causes of mistakes.

With the think-aloud strategy, the student was encouraged to express their thoughts verbally during the lesson, and with the journaling strategy, the student was encouraged to express their thoughts about the study process and performance in writing. In this way, students monitored their thoughts both verbally and in writing and directed the performance process according to their needs. In the study, "keeping a diary" was used as a metacognitive strategy and data collection tool.

Apart from these strategies, the Strategy Evaluation Matrix prepared by the researcher, which includes some learning strategies that can be used in piano education, was given to the students. This matrix includes strategies such as marking, mental repetition, grouping, simulation, summarizing, etc., and the answers to the questions "how to use," "when to use," and "why to use" regarding the use of these strategies. This matrix was used during the lesson to help students think about which strategies they can use in their work and to mobilize their procedural and conditional knowledge in this direction.

In the posttest phase of the experimental process, the students' piano performances of the last test piece were recorded to be evaluated with PPRMP, and the MAI was answered by the students. The experimental process of the research is shown in Figure 1.

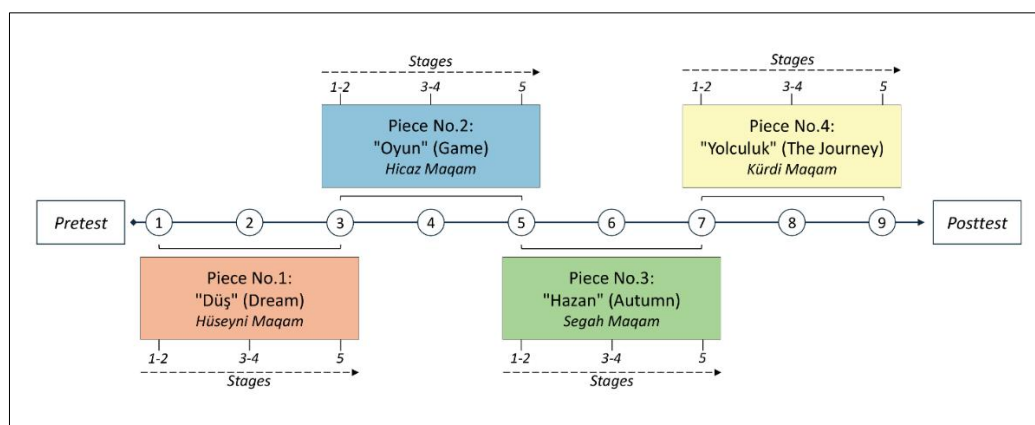


Figure 1. Experimental process of research

Data Analysis

In the study, descriptive statistics values of the pretest and posttest scores obtained with MAI and PPRMP were examined, and normality analyses were performed. The statistical significance value was accepted as $p < .05$.

Table 1. Descriptive statistics for measurements

Measurements	N	Mean	Median	SD	Minimum	Maximum	Skewness	Kurtosis
MAI Pretest	8	188.75	188.00	26.80	156	227	.237	-1.396
MAI Posttest	8	202.13	194.50	27.52	168	242	.591	-.969
PPRMP Pretest	8	74.75	73.67	12.46	59	93	.296	-1.155
PPRMP Posttest	8	95.38	95.33	12.16	73	118	.040	3.142

Descriptive statistics of the obtained scores are presented in Table 1. In this direction, it was examined whether the pretest and posttest scores of both scales showed normal distribution. It is seen that the arithmetic means and median values of MAI and PPRMP pretest and posttest are close to each other. It is recommended that the skewness and kurtosis values in a data set should be in the range of ± 1 to show a normal distribution (Huck, 2012). According to the results obtained, it is seen that the skewness coefficients are within the range of ± 1 , and the kurtosis coefficients take values outside these limits. In addition, the normality assumption for the pretest-posttest difference scores of the MAI and PPRMP was examined with the Shapiro-Wilk test. According to the results of the analysis, it was observed that the difference scores for MAI ($SW = .880$, $df = 8$, $p = .187$) and PPRMP ($SW = .990$, $df = 8$, $p = .994$) showed a distribution close to normal. Although the data obtained from both measurement tools indicate a normal distribution, it is recommended to use nonparametric tests when working with small samples (Can, 2023; Köklü et al., 2021; Mishra et al., 2019). Therefore, the Wilcoxon signed-ranks test, one of the non-parametric tests, was used to analyze the difference in measurements. The effect size was analyzed by calculating the r effect value. In the interpretation of the calculated r -effect sizes, the thresholds suggested by Cohen (1988), "0.10 = small effect, 0.30 = medium effect, 0.50 = large effect," were used (as cited in Kilmen, 2020).

In the descriptive statistics tables for the dimensions of MAI and PPRMP, raw score means, and median values of the relevant dimensions are presented together (see Tables 3 and 5). In addition, transformed mean scores were obtained for a more straightforward interpretation of the scores by dividing the raw score by the total number of items belonging to the dimensions. These scores ranged between 1.00-5.00 and were interpreted according to the evaluation criteria specified for the scale scores (see Data Collection Tools).

Table 2. Inter-rater Reliability Results for Piano Performance Assessment

Measurements	N	Kendall's W	<i>p</i>
Pretest	3	.965	.005
Posttest	3	.920	.007

In the study, the piano performances of the study group were evaluated by three field experts through PPRMP. Kendall's Coefficient of Concordance was applied to examine the inter-rater agreement (Table 2). According to the results obtained, a statistically significant and high agreement was found between the raters ($W_{\text{Pretest}} = .965$; $W_{\text{Posttest}} = .920$; $p < .05$).

The qualitative data collection tool of the study, the piece study diaries, was analyzed using a descriptive analysis method. Descriptive analysis is an analysis method based on summarizing and interpreting data according to previously determined themes (Yıldırım & Şimşek, 2016). In this direction, first of all, a literature review was conducted on the theoretical structure of metacognition and metacognitive behaviors that occur in music performance, and in line with the studies examined (Akin & Abacı, 2011; Benton, 2013; Boğar, 2018; Hallam, 2001; Kincannon et al., 1999; Li et al., 2023; Sever, 2017; Whitebread et al., 2009) a qualitative analysis framework was created in accordance with Schraw and Dennison's (1994) metacognition model. Then, the researcher conducted a preliminary review of the diary data; the diaries were read many times at different times, and the student expressions were evaluated to see whether they reflected metacognition. The compatibility of the qualitative analysis framework with the data from the study diaries was reviewed and made ready for the coding process. For the diary data, the researcher and an academican carried out a coding study with the title of professor specializing in music education. At the end of the coding process, the inter-coder agreement was calculated as 94% in line with Miles and Huberman's (2021) intercoder reliability formula [$\text{Reliability} = \text{Agreement} / (\text{Agreement} + \text{Disagreement}) \times 100$]. According to the results obtained, it was determined that the codings were consistent with each other. In addition, the categories obtained in line with the coded statements were checked by an academican specialized in educational sciences.

After the coding of the qualitative findings, frequency analysis was performed on the codes related to the dimensions of metacognition. In presenting the findings, directly quoted student statements are given along with the student number and the diary number in which the statement appears. For instance, the code "S1.2a" refers to the statement in the lesson diary kept by student number 1 in week 2, while the code "S1.2b" refers to the statement in the self-study diary of the same student in week 2.

FINDINGS

Findings from the Metacognitive Awareness Inventory (MAI)

In order to compare the metacognitive awareness levels of the study group before and after the intervention, the pretest and posttest mean scores of the metacognitive essential dimensions are presented in Table 3.

Table 3. Descriptive statistics according to metacognitive awareness dimensions

Metacognitive Awareness Dimensions	Pretest Mean	Pretest Median	Pretest Transformed Mean Score	Posttest Mean	Posttest Median	Posttest Transformed Mean Score
Knowledge of Cognition	64.13	63.50	3.77	124.63	124.50	4.06
Regulation of Cognition	68.25	66.50	3.56	133.88	128.00	3.83

As seen in Table 3, the mean and median values of the pretest and posttest scores for both dimensions of metacognitive awareness are close to each other. When the transformed scores were analyzed, it was understood that the study group showed high metacognitive awareness both in the pretest and posttest. An increase in posttest scores was observed in both dimensions. To examine whether there was a difference in the metacognitive awareness scores of the study group before and after the experimental process, the Wilcoxon signed-rank test was applied, and the findings are presented in Table 4.

Table 4. Wilcoxon Signed-Rank Test Results for Metacognitive Awareness Scores

Posttest - Pretest	n	Mean Rank	Sum of Ranks	<i>z</i>	<i>p</i>	<i>r</i>
Negative Ranks	1	1.00	1.00	-2.383	.017	-.84
Positive Ranks	7	5.00	35.00			
Ties	0					

According to the Wilcoxon signed-rank test results given in Table 4, there was a statistically significant difference between the MAI pretest and posttest scores of the study group ($z = -2.383$, $p < .05$). Considering the rank averages and rank sums, it was determined that the difference was in favor of the posttest MAI score. From this point of view, it can be said that the process of studying maqam-based pieces based on metacognitive strategies is effective in improving students' metacognitive awareness levels. The fact that seven students' posttest scores were higher than their pretest scores and one student's posttest score decreased shows that the study process created a positive result in general. In addition, the effect size obtained shows that the experimental process has a great effect on students' metacognitive awareness levels ($r = -.84$).

Findings from the Piano Performance Rubric for Maqam-based Pieces (PPRMP)

To compare the piano performance levels of the study group before and after the intervention, the pretest and posttest mean scores of the performance dimensions are presented in Table 5.

Table 5. Descriptive statistics according to piano performance dimensions

Piano Performance Dimensions	Pretest Mean	Pretest Median	Pretest Transformed Mean Score	Posttest Mean	Posttest Median	Posttest Transformed Mean Score
Knowledge Dimension	16.96	15.00	2.83	22.46	23.34	3.74
Technical Dimension	44.54	45.67	3.18	56.00	54.67	4.00
Musical Expression Dimension	13.25	12.50	2.65	17.10	16.83	3.38

According to Table 5, the mean and median values of the pretest and posttest scores for all piano performance dimensions are close to each other. When the mean scores of the study group regarding the piano performance dimensions are examined, it is seen that they performed at a medium level in all dimensions in the pretest. In the posttest, while there was a high level of performance in the knowledge dimension and technical dimension, the performance level in the musical expression dimension remained at a medium level. However, when all dimensions are taken into consideration, it is observed that there is a specific increase in the posttest score averages compared to the pretest. To examine whether there was a difference in the piano performance scores of the study group before and after the experimental process, the Wilcoxon signed-rank test was applied, and the findings are presented in Table 6.

Table 6. Wilcoxon Signed-Rank Test Results for Piano Performance Scores

Posttest - Pretest	n	Mean Rank	Sum of Ranks	z	p	r
Negative Ranks	0	.00	.00	-2.521	.012	-.89
Positive Ranks	8	4.50	36.00			
Ties	0					

According to the test results given in Table 6, there was a statistically significant difference between the PPRMP pretest and posttest scores of the study group ($z=-2.521, p<.05$). When the rank averages and sums are evaluated, it is seen that this difference is in favor of positive ranks, that is, the posttest score. These findings show that the process of studying maqam-based pieces utilizing metacognitive strategies is effective in improving students' piano performance levels. In addition, the calculated effect size shows that the experimental process has a large effect on students' piano performance levels ($r = -.89$).

Findings from the Piece Study Diaries

The use of metacognitive knowledge and metacognitive regulation activities of the study group was determined through the piece study diaries. The total number of diaries kept by the students during the process was 128. It was determined that 318 sentences in these diaries reflected metacognition.

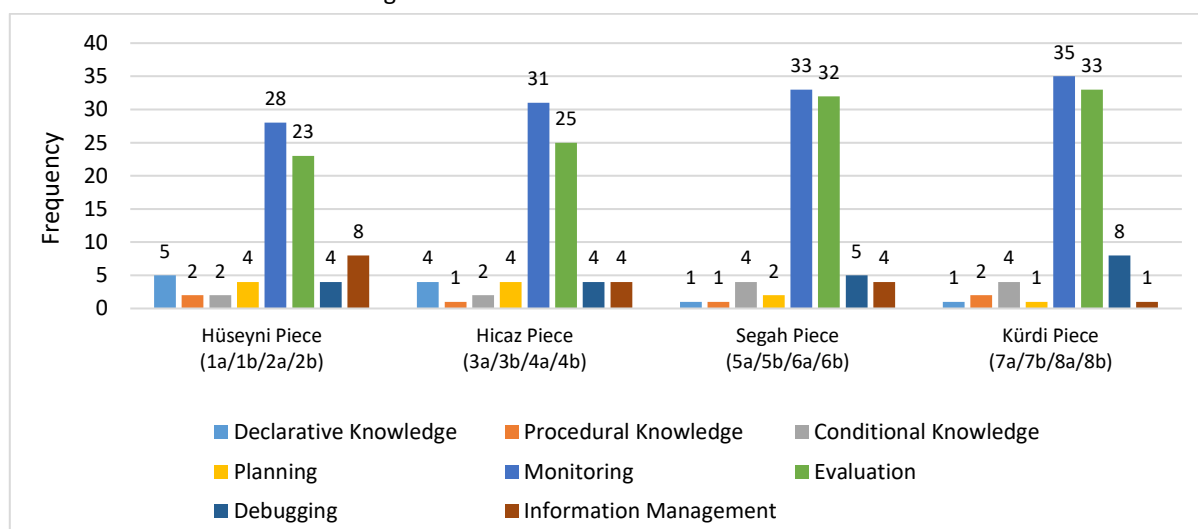


Figure 2. The distribution of student expressions in the diaries in the process of studying maqam-based pieces according to metacognitive dimensions

As can be seen in the graph above (Figure 2), the practices carried out by the students during the process of studying maqam-based pieces are mainly related to the monitoring and evaluation dimensions. It is understood that the students made metacognitive monitoring of their thoughts and learning processes in each piece they worked on during the process and metacognitive evaluation at the end of the process. An increase is observed in the students' statements regarding metacognitive monitoring and evaluation from the first piece (Hüseyni Piece) to the last piece (Kürdi Piece). It was determined that the

expressions related to other metacognitive sub-dimensions were encountered less frequently than the monitoring and evaluation expressions. The frequency values of the expressions related to these dimensions did not change much during the process.

Regarding the monitoring dimension, it was observed that the students identified the mistakes they made during the performance, the weaknesses of the performance, and the difficulties they encountered in their performance; they controlled their focus and the problems they experienced in this regard, and they directed themselves to improve their performance. In this context, in line with the statements, it was understood that the students consciously monitored their learning processes and performances with awareness. For example, one of the students said, "I tried to pay attention to all the techniques and nuances from the beginning of the piece." (S4.5b.) and explained what he directed his attention to in his performance, while another student said, "When I tried to play fast, I could not use the pedal correctly." (S6.2a.), and explained a mistake he made during his performance. All the works studied generally observed such tendencies toward watching the performance.

In the evaluation dimension, it was determined that the students evaluated the realization of their goals during the study process, their comprehension of the learned task, their knowledge and skill gains, the effects of the strategies they used on their performances, their success and development status, and determined the requirements for better progress in the following performance processes. It was observed that the most common statements in the evaluation dimension included evaluating the effects of the strategies, as in the statement, "I think that I applied the term 'espressivo,' which I just learned, correctly since I identified the chords in the piece and made groupings, coded the notes visually and played the transcription with its nuances from the beginning." (S4.7b.). In addition, statements in which the requirements for a better performance were identified were also frequently encountered, such as "I do not think my playing performance is bad, but I need to complete my knowledge deficiencies." (S2.1a.).

Statements about declarative knowledge, procedural knowledge, conditional knowledge, planning, debugging, and information management were rarely found in the diaries. Students who reflected their declarative knowledge in their diaries generally expressed how their learning processes worked and the strengths and weaknesses they saw in themselves during the learning process. Statements such as "I have a strong visual memory." (S5.2a.), "I have some difficulty deciphering because of my lack of studying or not working in a programmed way." (S1.1a.) indicates that students have an awareness of their own cognitions and, more broadly speaking, their own learning processes.

Statements about declarative knowledge, procedural knowledge, conditional knowledge, planning, debugging, and information management were rarely found in the diaries. Students who reflected their explanatory knowledge in their diaries generally expressed how their learning processes worked and the strengths and weaknesses they saw in themselves during the learning process. Statements such as "I have a strong visual memory." (S5.2a.), "I have some difficulty deciphering because of my lack of studying or not working in a programmed way." (S1.1a.) indicates that students have an awareness of their own cognitions and, more broadly speaking, their own learning processes.

Considering procedural and conditional knowledge, it was found that students knew some learning strategies to be used in piano studies and in which situations they would use these strategies. When the student expressions related to these two dimensions were examined, it was observed that one student reflected his procedural knowledge as "When I went out, when I was doing chores at home, when I was traveling, when I was sitting, and even before I fell asleep, I did mental repetitions and exercises on how I should work on the pedal." (S3.2b.). Another student conveyed his situational knowledge, including the reason for using the strategy: "Since there were patterns that I had not practiced before, I started to separate these patterns in terms of duration and by counting and marking them." (S8.5b.).

Regarding the planning dimension, which is one of the rarely encountered dimensions, it was observed that the students set some goals for the piece, identified the strategies they could apply, and made a time plan to complete the piece. "My goal while practicing this piece is to practice more frequently than usual, to reinforce my ear familiarity with the related maqam, and to perform all the details of the piece fully." (S4.1a.); the same student also made a time plan for the same piece and expressed it as follows: "Since I had already looked at the piece I was going to study, I thought that 40 minutes would be enough for me today, and I made my plan in advance in such a way that no external factor could interrupt this time." (S4.1b.).

It was determined that the students who used debugging strategies generally used different strategies such as marking, repeating, practicing slowly, practicing with a metronome, and practicing with two hands together/separately to eliminate the mistakes and difficulties they made in their performances during the experimental process. One student expressed the use of strategies to correct errors in her performance as follows: "Although there were no errors in the measures themselves, there were errors in the connections, so I practiced by connecting two measures with the next two measures." (S7.7b.). Similarly, another student reflected on her use of strategy to overcome the difficulties she experienced in her performance as follows: "I tried to work on the difficult parts differently by developing my own strategy." (S3.5b.).

It has been observed that students who use information management strategies use strategies such as marking, taking notes, repeating, and thinking out loud to remember and consolidate new information they encounter during the study of the maqam-based piece and to focus on information they consider important. Students encountered theoretical information about maqams that they had not encountered before, as well as many different terms and signs related to nuance, tempo, and techniques. Accordingly, it was determined that the students made an effort to learn the information they encountered during the process. The student used the repetition strategy to remember the information encountered in the piece with the statement, "I reminded

myself by repeating the information in the piece from time to time in order not to forget it.” (S5.8b.). Similarly, the same student conveyed the strategy she used to reinforce the information he encountered with the expression, “To be honest, I played the piece very slowly on purpose to get the number of measures well-established without speeding up the piece.” (S5.6b.).

DISCUSSION, CONCLUSION AND SUGGESTIONS

This study aimed to examine the effect of metacognitive strategies on students' metacognitive awareness and piano performance levels and to determine the metacognitive knowledge and regulation activities used by students during the study process. According to the results of the analyses related to the quantitative dimension of the study, it was determined that the use of metacognitive strategies in the process of studying maqam-based pieces significantly affected the metacognitive awareness levels and piano performance levels of the students. Bonnaire and González-Moreno (2023) concluded that the development of metacognitive awareness in piano education positively affects piano performance success. T. Yokuş (2010) conducted activities to develop metacognitive skills within the scope of guitar education and concluded that these activities effectively increased guitar students' metacognitive awareness levels, performance success, and knowledge levels about guitar lessons. H. Yokuş (2010), who examined the effects of using learning strategies in piano education, found that it increased students' performance success and metacognitive awareness levels. In this study, students were given information about learning strategies and the reasons for their use through a strategy evaluation matrix. In this context, it can be said that the direct transfer or indirect application of strategies for developing learning strategies and metacognition in the instrument training process has a positive effect on students' instrument performances.

Brundage (2019) examined the metacognitive habits of twelve piano students through self-report and suggested that the performance levels of students with high metacognitive skills were higher than those of students with low metacognitive skills. Ferenc (2016), who conducted research within the scope of the music theory course of music education, observed that using metacognitive reflection assignments improved students' skills, such as understanding their own learning processes, identifying their strengths and weaknesses, and evaluating the learning strategies they use. In this study, students reflected on their learning situations through organizer checklist questions, think-aloud strategy, and piece study journals. As a result, it was determined that the student's metacognitive awareness and piano performance levels improved after the experimental process.

According to the findings obtained from the qualitative dimension of the study, it was determined that the students frequently used metacognitive monitoring and metacognitive evaluation skills during the process of studying maqam-based pieces. In the statements reflected in the piece study diaries, it was observed that the students conveyed less about the knowledge dimension of cognition than the regulation dimension of cognition. Piano education is a process that requires the student to monitor their performance, direct their thoughts, and instantly find solutions to the difficulties or mistakes they encounter. In this respect, the fact that the students' statements about metacognitive monitoring and metacognitive evaluation were encountered intensively in the study is consistent with the structure of the study process.

Power and Powell (2018), who examined the metacognitive approaches used by young string musicians in their practice, observed that musicians make plans for the area that needs to be improved in their practice, choose appropriate strategies to eliminate deficiencies or develop a specific skill, and evaluate their learning processes. At the end of the process, it was revealed that the efficiency level obtained from the study processes increased, and musicians realized a better understanding of their practices. In this study, it was observed that the students made plans such as organizing time, choosing strategies, identifying the deficiencies in their performances, and the subjects in which they were competent, and evaluating their performances in their piece study diaries.

Colombo and Antonietti (2017), in their study, observed a piano teacher and four students of the teacher and found that the teacher mainly used metacognitive regulation in the lesson and used metacognitive knowledge less. It was also observed that the students mainly used metacognitive control strategies related to metacognitive regulation in the lesson. As can be seen, the use of metacognitive regulation skills in piano lessons is a common situation. In this study, it was found that metacognitive knowledge awareness was higher than metacognitive regulation awareness while students transferred their metacognitive awareness through self-report via MAI. In the piece study diaries, students tended to reflect more on their metacognitive regulation activities than on their metacognitive knowledge. This difference observed between the results shows that the students reflected their high awareness of their metacognitive knowledge through metacognitive monitoring and evaluation in the process of studying maqam-based pieces within the scope of the piano lesson.

This study has some limitations, such as the fact that the study group consisted of eight students, specific metacognitive strategies were used, and four maqam-based pieces were studied in the study process. Considering these limitations, the following suggestions are offered for future research and applications to produce more generalizable results and to examine metacognitive approaches from different perspectives:

1. Conducting experimental studies with a larger sample group, metacognitive strategies will provide more generalizable results. In addition, in-depth research with students with different performance levels will enable the qualitative findings obtained on the use of metacognition in instrumental performance to be addressed from a different perspective.
2. To examine the use of metacognition in the performance process in more detail, students' metacognitive knowledge and skills can be examined on one etude or one piece written in forms such as sonata, prelude, and fugue instead of working

on multiple different pieces. Considering the views that metacognitive experiences are more likely to occur in situations that require high levels of conscious thinking (Flavell, 1979), it would be helpful to consider the performance level of the students and the musical and technical elements of the works in the selection of the works to be studied for students to use metacognitive skills more intensively.

3. In individual instrument lessons given within the scope of vocational music education, it is important for students to recognize their own learning process and to organize their studies in this direction. In this context, it would be useful for instructors to sample their own use of metacognition in individual instrument lessons and to encourage metacognitive thinking by enabling students to reflect on their thinking processes verbally and in writing. Such studies will enable students to develop metacognitive knowledge and skills, thus, self-regulation competencies. In this direction, it is recommended that educators should systematically include strategies and activities for the development of metacognitive awareness and metacognitive skills in their lesson plans.
4. Students' metacognitive activities during the piano practice process can be categorized in different ways, such as low, medium, high, or sufficient, insufficient. Thus, the relationship between students' metacognitive use and piano skills can be systematically analyzed.
5. Apart from individual piano lessons, in group piano studies within the scope of orchestra lessons, students' metacognitive planning, monitoring, and evaluation before, during, and after the performance, and expressing them through thinking aloud will enable knowledge transfer between students through peer learning. In this way, students will learn different methods and strategies for piano studies and gain different experiences. It is recommended that teachers and researchers use such studies in lessons and evaluate their effects.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

This research is based on the first author's PhD thesis and was supported by the Scientific and Technological Research Council of Türkiye (TÜBİTAK) under the 2211-A National Doctoral Scholarship Program.

Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The research process's theoretical framework, methodology, and design were carried out in collaboration with the first and second authors. Data collection, data analysis, evaluation of the findings, and manuscript drafting were carried out by the first author under the supervision of the second author. The second author contributed to revising the study's methodological approach and the manuscript's final editing. Both authors read and approved the final version of the article.

Ethics Committee Approval Information

The study is derived from the first author's doctoral dissertation. Ethics committee approval for the study was obtained at the Gazi University Ethics Commission meeting dated 07.02.2023 and numbered 02 with the research code 2023-106.

REFERENCES

- Akın, A., & Abacı, R. (2011). *Biliş ötesi*. Nobel.
- Akın, A., Abacı, R., & Çetin, B. (2007). Bilişötesi Farkındalık Envanteri'nin Türkçe formunun geçerlik ve güvenirlik çalışması. *Kuram ve Uygulamada Eğitim Bilimleri*, 7(2), 655–680.
- Albuz, A. (2020). Türk müziğinde çokseslilik yaklaşımlarına genel bir bakış. *Afyon Kocatepe Üniversitesi Akademik Müzik Araştırmaları Dergisi*, 6(Special issue), 374–398. <https://dergipark.org.tr/tr/pub/amader/issue/56876/769714>
- Avcı Akbel, B. (2019). Müzik eğitiminde bilişötesi stratejilerin kullanımı. In B. A. Akbel (Ed.), *Güzel Sanatlar Eğitimi Araştırmaları I* (pp. 1–12). Akademisyen Kitabevi.
- Baker, L., & Brown, A. L. (1980). *Metacognitive skills and reading*. (ERIC Document Reproduction Service No. ED195932). <http://files.eric.ed.gov/fulltext/ED195932.pdf>
- Bathgate, M., Sims-Knight, J., & Schunn, C. (2012). Thoughts on thinking: Engaging novice music students in metacognition. *Applied Cognitive Psychology*, 26(3), 403–409. <https://doi.org/10.1002/acp.1842>
- Benton, C. W. (2013). Promoting metacognition in music classes. *Music Educators Journal*, 100(2), 52–59. <https://doi.org/10.1177/0027432113500077>
- Benton, C. W. (2014). *Thinking about thinking: Metacognition for music learning*. Rowman & Littlefield Education.

- Blakey, E., & Spence, S. (1990). *Developing metacognition*. ERIC Digest. <https://eric.ed.gov/?id=ED327218>
- Boğar, Y. (2018). Literature review on metacognition and metacognitive awareness. *Anatolian Journal of Teacher*, 2(2), 136–168. <https://dergipark.org.tr/tr/download/article-file/613670>
- Bonnaire, S., & González-Moreno, P. (2023). Developing metacognition as an instructional approach for enhancing young pianists' musical expressivity. *International Journal of Music Education*, 41(2), 199–210. <https://doi.org/10.1177/02557614221115805>
- Brown, A. (1987). Metacognition, executive control, self-regulation, and other more mysterious mechanisms. In F. Weinert & R. Kluwer (Eds.), *Metacognition, motivation and understanding* (pp. 65–116). Erlbaum.
- Brundage, S. (2019). Metacognition and music: An investigative study among collegiate piano majors. *Piano Pedagogy Forum*, 20(2), 2–16. https://pianoinspires.com/wp-content/uploads/2022/08/Piano_Pedagogy_Forum_-_Volume_20_-_No.2_-_November_2019.pdf
- Can, A. (2023). *Spss ile bilimsel araştırma sürecinde nicel veri analizi* (11th ed.). Pegem Akademi.
- Colombo, B., & Antonietti, A. (2017). The role of metacognitive strategies in learning music: A multiple case study. *British Journal of Music Education*, 34(1), 95–113. <https://doi.org/10.1017/S0265051716000267>
- Concina, E. (2019). The role of metacognitive skills in music learning and performing: Theoretical features and educational implications. *Frontiers in Psychology*, 10, 1583. <https://doi.org/10.3389/fpsyg.2019.01583>
- Costa, A. L. (1984). Mediating the metacognitive. *Educational Leadership*, 42(3), 57–62. https://files.ascd.org/staticfiles/ascd/pdf/journals/ed_lead/el_198411_costa.pdf
- Creswell, J. W., & Plano Clark, V. L. (2020). Karma yöntem desen seçimi (A. Delice, Trans.). In Y. Dede & S. B. Demir (Trans. Eds.), *Karma yöntem araştırmaları: Tasarımı ve yürütülmesi* (pp. 61–117). Anı Yayıncılık. (Original work published 2011).
- Deniz, J. (2015). Müzik öğretmeni adaylarının bilişötesi öğrenme stratejilerini kullanma düzeyleri. *Akademik Sosyal Araştırmalar Dergisi*, (14), 1–14. <https://doi.org/10.16992/ASOS.667>
- Ergin, E., & Durak, Y. (2016). Bilişüstü özdüzenlemenin deşifre çalma becerisine ve deşifre çalma tutumuna etkileri. *Uluslararası Eğitim Bilimleri Dergisi*, 3(7), 131–158. <https://doi.org/10.16991/INESJOURNAL.246>
- Ferenc, A. (2016). Promoting metacognitive reflection in music theory instruction. *Journal of Music Theory Pedagogy*, 30, 23–85. <https://doi.org/10.71156/2994-7073.1183>
- Flavell, J. H. (1976). Metacognitive aspects of problem solving. In L. Resnick (Ed.), *The nature of intelligence* (pp. 231–236). Lawrence Erlbaum.
- Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist*, 34(10), 906–911. <https://doi.org/10.1037/0003-066X.34.10.906>
- Fleur, D. S., Bredeweg, B., & van den Bos, W. (2021). Metacognition: Ideas and insights from neuro- and educational sciences. *npj Science of Learning*, 6(1), 13. <https://doi.org/10.1038/s41539-021-00089-5>
- Grançer Okay, N. (2010). *Piyano performansının değerlendirilmesi* (Publication No. 261969) [Doctoral dissertation, Marmara University]. YÖK Ulusal Tez Merkezi. <https://tez.yok.gov.tr/UlusalTezMerkezi/tezDetay.jsp?id=b6KgOfc3sRGHrLy0r7ByGw&no=IhLdQ4VGMFoc-ORoV5F3CQ>
- Güven, E., & Kılıç, D. B. Ç. (2021). Müzik öğretmeni adaylarının bilişötesi öğrenme stratejilerinin çeşitli değişkenler açısından incelenmesi. *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi*, (60), 480–509. <https://doi.org/10.21764/maeuefd.934739>
- Hallam, S. (2001). The development of metacognition in musicians: Implications for education. *British Journal of Music Education*, 18(1), 27–39. <https://doi.org/10.1017/S0265051701000122>
- Hartman, H. (1997). *Human learning and instruction*. City College of New York. https://www.researchgate.net/publication/313360794_Human_Learning_and_Instruction
- Huck, S. W. (2012). *Reading statistics and research*. Pearson.
- Jacobs, J. E., & Paris, S. G. (1987). Children's metacognition about reading: Issues in definition, measurement, and instruction. *Educational Psychologist*, 22(3-4), 255–278. <https://doi.org/10.1080/00461520.1987.9653052>
- Kaplan, G., & Aykut, Ç. (2022). Üstbiliş geliştirmek için düzenlenmiş olan öğretim etkinliklerinin öğretmen adaylarının üstbilişsel farkındalıklarına etkisinin incelenmesi. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Özel Eğitim Dergisi*, 23(1), 23–51. <https://doi.org/10.21565/oelegitimdergisi.715775>
- Kaynak, T. (2011). *Piyano eğitimi yarıyıl sonu sınavlarında öğrenci performansının rubrik ile ölçülmesi* (Publication No. 290513) [Doctoral dissertation, Gazi University]. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/tezDetay.jsp?id=Ux9sfzNKnyjeQKt8jfAfbQ&no=An5nBN_u_3Z_DamRQKekvw
- Kilmen, S. (2020). *Eğitim araştırmacıları için spss uygulamalı istatistik* (3rd ed.). Anı Yayıncılık.
- Kincannon, J., Gleber, C., & Kim, J. (1999). *The effects of metacognitive training on performance and use of metacognitive skills in self-directed learning situations*. (ERIC Document Reproduction Service No. ED436146). <https://files.eric.ed.gov/fulltext/ED436146.pdf>

- Köklü, N., Büyüköztürk, Ş., & Çokluk, Ö. (2021). *Sosyal bilimler için istatistik* (25th ed.). Pegem Akademi.
- Li, W., Manoharan, P., Cui, X., & Liu, F. (2023). The development and validation of a metacognitive questionnaire for music learning. *TEM Journal*, 12(2), 1090–1099. <https://doi.org/10.18421/TEM122-55>
- Machfauzia, A. N., Djohan, D., & Sittiprapaporn, P. (2020). Intellectual character of metacognition in thinking strategies. *Asian Journal of Medical Sciences*, 11(1), 51–56. <https://doi.org/10.3126/ajms.v11i1.26519>
- Miles, M. B., & Huberman, A. M. (2021). Analizde ilk adımlar (A. Ersoy, Trans.). In S. Akbaba Altun & A. Ersoy (Eds.), *Genişletilmiş bir kaynak kitap: Nitel veri analizi* (4th ed., pp. 50–89). Pegem Akademi. (Original work published 1994).
- Mine, T. (2012). *Piyano eğitiminde rubrik ile geleneksel ölçme-değerlendirme yöntemlerinin karşılaştırılması (İnönü Üniversitesi örneği)* (Publication No. 314196) [Master's thesis, İnönü University]. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/tezDetay.jsp?id=Zn5CgrBWLKfYiQaAMPuoTw&no=cE89fj_S1OHhrnTrbCJB_A
- Mishra, P., Pandey, C. M., Singh, U., Keshri, A., & Sabaretnam, M. (2019). Selection of appropriate statistical methods for data analysis. *Annals of Cardiac Anaesthesia*, 22(3), 297–301. https://doi.org/10.4103/aca.ACA_248_18
- Papaleontiou-louca, E. (2003). The concept and instruction of metacognition. *Teacher Development*, 7(1), 9–30. <https://doi.org/10.1080/13664530300200184>
- Paris, S. G., & Winograd, P. (1990). Promoting metacognition and motivation of exceptional children. *Remedial and Special Education*, 11(6), 7–15. <https://doi.org/10.1177/074193259001100604>
- Pintrich, P. R., Wolters, C. A., & Baxter, G. P. (2000). Assessing metacognition and self-regulated learning. In G. Schraw & J. Impara (Eds.), *Issues in the measurement of metacognition* (pp. 43–97). University of Nebraska Press.
- Power, A. M., & Powell, S. J. (2018). Engaging young string players in metacognition. *International Journal of Music Education*, 36(4), 659–670. <https://doi.org/10.1177/0255761418771989>
- Sakarya, G., & Şendurur, Y. (2020). Anlamayı izleme stratejilerinin keman öğrencilerinin bilişötesi farkındalık düzeyine etkisi. *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi*, (53), 435–457. <https://doi.org/10.21764/maeuefd.632135>
- Schraw, G., & Dennison, R. S. (1994). Assessing metacognitive awareness. *Contemporary Educational Psychology*, 19(4), 460–475. <https://doi.org/10.1006/ceps.1994.1033>
- Schraw, G., & Moshman, D. (1995). Metacognitive theories. *Educational Psychology Review*, 7(4), 351–371. <https://doi.org/10.1007/BF02212307>
- Schraw, G. (1998). Promoting general metacognitive awareness. *Instructional Science*, 26(1), 113–125. <https://doi.org/10.1023/A:1003044231033>
- Sever, G. (2017). Müzik performansının alt beceri alanlarına ilişkin müzisyenlerin algıları. *Turkish Studies*, 12(17), 371–396. <https://doi.org/10.7827/TurkishStudies.11847>
- Tobias, S., & Everson, H. T. (2002). *Knowing what you know and what you don't: Further research on metacognitive knowledge monitoring*. (Research Report No. 2002-3). College Entrance Examination Board. <https://files.eric.ed.gov/fulltext/ED562778.pdf>
- Tuğcular, E. (2003). *Türkünün Rengi: Piyano için 23 Parça* (Expanded 2nd ed.). Özkan Matbaacılık.
- Tuğcular, E. (2017). *Piyano Albümü: Anadolu Ezgileri*. Arkadaş Yayınevi.
- Tunç, T. (2016). Polifonik nihaent bir piyano eserinin seslendirilmesine yönelik öğrenci performanslarının incelenmesi. *Eğitim ve Öğretim Araştırmaları Dergisi*, 5(Special issue), 361–379. http://www.jret.org/FileUpload/ks281142/File/40.turgay_tunc.pdf
- Turgut, Ş., & Dalkıran, E. (2021). Piyano eğitimi dersi performans ölçümüne yönelik dereceli puanlama anahtarının geliştirilmesi: Geçerlik ve güvenirlik çalışması. *Sanat ve Tasarım Dergisi*, 11(2), 438–449. <https://doi.org/10.20488/sanattasarim.1048952>
- Whitebread, D., Coltman, P., Pasternak, D. P., Sangster, C., Grau, V., Bingham, S., Almeqdad, Q., & Demetriou, D. (2009). The development of two observational tools for assessing metacognition and self-regulated learning in young children. *Metacognition and Learning*, 4(1), 63–85. <https://doi.org/10.1007/s11409-008-9033-1>
- Wilson, J. (1999). Defining metacognition: A step towards recognising metacognition as a worthwhile part of the curriculum [Paper presentation]. AARE Conference, Melbourne, Australia. <https://www.aare.edu.au/data/publications/1999/wil99527.pdf>
- Yeşilyurt, S., & Çapraz, C. (2018). Ölçek geliştirme çalışmalarında kullanılan kapsam geçerliği için bir yol haritası. *Erzincan Üniversitesi Eğitim Fakültesi Dergisi*, 20(1), 251–264. <https://doi.org/10.17556/erziefd.297741>
- Yıldırım, A., & Şimşek, H. (2016). *Sosyal bilimlerde nitel araştırma yöntemleri*. Seçkin.
- Yokuş, H. (2010). Piyano eğitiminde öğrenme stratejilerinin kullanılmasının öğrencilerin başarılarına ve üstbilişsel farkındalıklarına etkisi. *Marmara Üniversitesi Atatürk Eğitim Fakültesi Eğitim Bilimleri Dergisi*, 31, 145–160. <https://dergipark.org.tr/tr/download/article-file/1657>
- Yokuş, T. (2010). Üstbilişin gitar performans başarısına etkisi. *Marmara Üniversitesi Atatürk Eğitim Fakültesi Eğitim Bilimleri Dergisi*, 31, 161–175. <https://dergipark.org.tr/tr/download/article-file/1658>



| Research Article / Araştırma Makalesi |

Examining the Use of AI-Powered Chatbots in Education

Yapay Zekâ Destekli Sohbet Robotlarının Eğitimde Kullanımının İncelenmesi

Abdullah Ragıp ERSÖZ¹

Keywords

- 1.Chatbots
- 2.Artificial intelligence
- 3.Instructional technology
- 4.Pre-service teachers

Anahtar Kelimeler

- 1.Sohbet robotları
- 2.Yapay zekâ
- 3.Öğretim teknolojileri
- 4.Öğretmen adayları

Received/Başvuru Tarihi

25.11.2024

Accepted / Kabul Tarihi

25.07.2025

Abstract

Purpose: Understanding the perspectives of pre-service teachers on the use of chatbots in education, while balancing the opportunities and risks these technologies offer, can provide a more comprehensive understanding of their future potential uses. This study aims to explore the opinions of pre-service teachers about AI-powered chatbots.

Design/Methodology/Approach: In this study, a case study method was adopted, enabling the analysis of educational, socio-cultural, and individual interactions. An open-ended questionnaire was administered to 34 pre-service teachers. The data were analyzed using descriptive analysis and categorized under four main themes.

Findings: The analysis revealed that pre-service teachers generally hold positive views about the use of AI-powered educational technologies in various areas. However, some participants expressed concerns about the systems' insufficiencies in fostering motivation and enhancing teacher-student interaction.

Highlights: The findings indicate that participants were particularly satisfied with the ability of AI-powered chatbots to provide clear and concise information. They identified quick and organized access to information as the most significant advantage of chatbots. The study also suggests experimental applications to enhance the potential of chatbots in providing motivation and emotional support, enabling them to play a more complementary role in classroom interactions.

Öz

Çalışmanın amacı: Öğretmen adaylarının eğitimde sohbet robotlarının kullanımına dair görüşleri, bu teknolojilerin eğitimde sunduğu fırsatlar ve riskleri dengeli bir biçimde ele alarak, gelecekteki potansiyel kullanımlarını daha kapsamlı bir şekilde anlamamızı sağlayabilir. Bu çalışma, öğretmen adaylarının yapay zekâ destekli sohbet robotları hakkında görüşlerini incelemeyi amaçlamaktadır.

Materyal ve Yöntem: Bu çalışmada, eğitsel, sosyo-kültürel ve bireysel etkileşimlerin analizine olanak tanıyan bir durum çalışması yöntemi benimsenmiştir. Açık uçlu sorular ile hazırlanan anket formu, 34 öğretmen adayına uygulanmıştır. Veriler betimsel analiz ile 4 tema altında incelenmiştir.

Bulgular: Yapılan analiz sonucu, öğretmen adaylarının yapay zekâ destekli eğitim teknolojilerini birçok alanda oldukça olumlu karşıladıklarını göstermektedir. Buna karşın, katılımcılar arasında, yapay zekâ destekli sistemlerin motivasyon sağlama ve öğretmen-öğrenci etkileşimini artırma konusundaki yetersizliklerine dair bazı görüşler de dile getirilmiştir.

Önemli Vurgular: Araştırmada elde edilen bulgular, katılımcıların yapay zekâ destekli sohbet robotlarının açık ve net bilgi sağlama yeteneğinden memnun olduklarını ortaya koymuştur. Katılımcılar, bilgiyi hızlı ve derli toplu bir şekilde edinebilmelerini sohbet robotlarının en önemli avantajı olarak görmektedir. Araştırmada, yapay zekâ destekli araçların motivasyon sağlama ve duygusal destek sunma potansiyelini artırmaya yönelik deneysel uygulamalar, sınıf içi etkileşimlerde daha tamamlayıcı bir rol üstlenebilmesi için öneriler sunulmuştur.

¹ **Corresponded Author**, Bursa Uludağ University, Education Faculty, Department of Computer and Instructional Design Education, Bursa, TURKEY; <https://orcid.org/0000-0003-3519-8400>

INTRODUCTION

Problem Statement

The rapid advancements in artificial intelligence technologies in recent years have revealed a significant potential for transformation in the field of education. The opportunities offered by these technologies in reshaping modern educational processes are noteworthy, particularly in terms of enriching teaching materials and more effectively supporting students' individual learning pathways. However, there remain various uncertainties regarding the integration of such innovative technologies into educational systems. Educators often hesitate about the extent to which and how they can utilize AI-powered tools, as the meaningful contribution of these tools to student achievement has yet to be fully demonstrated. Indeed, studies suggest that AI tools provided to educators are still in the experimental stage and that their applications are far from being fully established, as they continue to evolve (Triberti et al., 2024). Addressing these uncertainties necessitates more in-depth and comprehensive research to make educational processes more efficient and effective with AI technologies.

The integration of AI technologies into educational processes has the potential to reshape the traditional roles of teachers. This potential could shift teachers' roles from being merely conveyors of information to becoming guides, supporters, and facilitators in the learning process. However, there is yet no consensus in the field of education about the direction and extent to which AI-powered tools will alter teachers' roles. Significant uncertainties remain regarding how teachers' professional roles and responsibilities will evolve in response to these new technologies. Particularly, AI applications like chatbots that directly interact with students have the potential to take over some of the traditional tasks of teachers. Yet, there is no clear framework for understanding how this shift will affect teacher-student relationships and pedagogical processes (Tzenov, 2023). Therefore, it is crucial to conduct in-depth research on whether AI-powered chatbots will serve as supportive tools for teachers or take over certain aspects of their roles.

Another critical question is the extent to which AI can replace teachers in the emotional, social, and cognitive dimensions of education, further amplifying existing uncertainties. Understanding how AI will transform teachers' professional development and classroom activities is strategically important for both educational policy and classroom practice. Clarifying the role and impact of AI-powered chatbots in education is vital to better evaluate teachers' perceptions of these technologies and their roles in instructional processes. The willingness and motivation of pre-service teachers to work with AI are directly linked to how much they embrace this technology in their professional lives. Therefore, exploring the views of pre-service teachers on AI-powered educational applications is crucial for predicting how future educational systems might take shape. The limited number of studies on AI-powered educational applications for teachers and pre-service teachers indicates that this field is still in its infancy. For AI to be effectively utilized in education, it is essential to first assess educational attitudes and professional competencies toward these technologies. Conducting more comprehensive research to address existing uncertainties will enhance educators' awareness of these technologies and contribute to their effective use.

Literature Review

Pre-service teachers' opinions on the use of chatbots in education can help us gain a more comprehensive understanding of their potential future applications by evaluating the opportunities and risks these technologies offer in a balanced manner. Chatbots like ChatGPT are believed to offer significant potential for providing learning support and delivering quick feedback (Bettayeb et al., 2024). By supporting personalized learning and offering content tailored to individual student needs, chatbots enable a student-centered approach in the teaching process. Similarly, they contribute significantly to administrative efficiency, helping teachers make more effective use of instructional materials. Research indicates that the scope of AI applications in education is expanding daily (Guan et al., 2020; Ouyang et al., 2022). In this context, AI applications in education provide a solid foundation for the integration of chatbots into educational processes. Chatbots alleviate teachers' workload in instructional management and student guidance, allowing them to dedicate more time to pedagogical efforts (Mashinchi, 2024).

Alongside these advantages, certain risks associated with chatbots have also been identified. Concerns have been raised about their potential negative impacts on critical thinking and creativity (Mustroph & Steinbock, 2024; Pesce & Blanco, 2024). It is particularly feared that students' over-reliance on such technologies could hinder the development of critical thinking skills. Additionally, there are concerns that chatbots like ChatGPT might lead to academic ethics issues, such as increasing the risk of plagiarism and undermining academic integrity (Pesce & Blanco, 2024). Studies focusing on such ethical issues in literature facilitate a better understanding of these concerns. Similarly, a study by Yiğci et al. (2024) examined the potential impacts of large language models in higher education. This study explored the effects of using chatbots in fields such as education, engineering, and healthcare, highlighting the innovative contributions these technologies could make, such as providing personalized learning experiences and supporting asynchronous learning. However, the study also emphasized that risks associated with these technologies—such as their potential negative impact on academic integrity, the spread of misinformation, biases, and other ethical and legal issues—have yet to be fully resolved.

The use of AI technologies in education is supported by research on employing machine learning and deep learning algorithms to enhance the functionality of chatbots (Guan et al., 2020; Ouyang et al., 2022). Studies in this field show that machine learning and deep learning improve chatbots' ability to provide intelligent responses and enhance user interactions. Research published in journals like the **International Journal of Artificial Intelligence in Education** offers valuable insights into the functionality and

user-friendliness of chatbots in education. The expanding role of AI in education is evident in the existing literature. Systematic reviews indicate that chatbots are actively used in areas such as teaching, management, and counseling, offering advantages like providing students with quick access to content and encouraging engagement in learning processes (Okonkwo & Ade-Ibijola, 2021). On the other hand, the main challenges related to implementing chatbots in education include ethical issues, difficulties in assessment and evaluation, and the need for monitoring and maintenance. These challenges underscore the importance of preserving education as a process enriched by human interaction and ethical values. The need for further research on issues such as ethical challenges and assessment-related difficulties associated with chatbots in education is emphasized.

Comprehensive analyses by Guan et al. (2020) reveal that the focus areas of AI applications in education have shifted over the past two decades. While the early 2000s research focused on AI-supported online learning systems, the 2010s saw a shift toward personalized learning systems and student profiling models. Since 2019, there has been increased interest in innovative technologies such as chatbots and augmented reality. This shift demonstrates the continuous evolution of AI applications in education, offering solutions tailored to different needs over time. Regarding the integration of AI applications in education, factors such as enhancing the existing technological infrastructure, processing more data, and designing more robust algorithms are essential considerations. These elements are critical for successfully integrating AI into education.

The benefits of chatbots in education include increasing student motivation, providing instant and rapid feedback, and facilitating content integration (Wollny et al., 2021). Research indicates that models like ChatGPT often surpass human instructors in generating detailed and consistent feedback when summarizing student performance (Dai et al., 2023). This capability can facilitate the development of students' learning skills. Moreover, chatbots streamline the educational process and guide students in their learning journeys while providing administrative and logistical support to reduce teachers' workloads. A study by Mokmin and Ibrahim (2021) found that chatbots developed for health literacy were considered beneficial by users and provided effective communication. These findings suggest that chatbots can be effective tools for information sharing not only in education but also in other fields.

Research shows that while chatbots offer many advantages in education, it is also crucial to address some ethical and pedagogical concerns. For chatbots like ChatGPT to be effectively utilized in education, an approach that considers the limitations of the technology, ethical concerns, and pedagogical requirements is essential. To ensure that students develop critical thinking skills and maintain academic integrity, various control mechanisms must be implemented during the integration of these tools into education. Existing literature provides valuable insights into how chatbots can be used in education and the risks associated with their use, but the development of these technologies continues. Increasing research on the potential future uses and benefits of chatbots in education is necessary to fill gaps in the literature. Conducting more in-depth studies on the effects of chatbots on critical thinking, ethical issues, and long-term educational outcomes will contribute to the healthy use of these technologies in education.

Within this framework, pre-service teachers' opinions on AI-supported educational processes may play a decisive role in determining the extent to which these technologies will penetrate education in the future. This study aims to examine pre-service teachers' opinions about AI-powered chatbots.

METHOD

Research Design

In this study, a case study method, which enables the analysis of educational, socio-cultural, and individual interactions, was adopted (Yin, 2009). Case studies require a clear definition of the main case to be examined and the identification of related topics to be excluded from the study to ensure the reliability of the research. In this context, the opinions of pre-service teachers were examined solely in terms of the extent to which the requirements of teaching were fulfilled. Other elements of teaching were excluded from the study. Accordingly, the use of AI-supported chatbots in education was selected as the single case for investigation.

Data Collection Tools

As a data collection tool, a survey form containing open-ended questions was developed. Through open-ended questions, the use of AI-supported chatbots in education was examined in depth. To analyze chatbots in terms of the requirements of teaching, the survey questions were created based on the four elements outlined in Perkins' (1992) Smart Schools. In this context, four questions were prepared to understand pre-service teachers' opinions on AI's ability to provide meaningful, clear, and understandable information, design and implement meaningful exercises, provide feedback, and maintain motivation. The prepared survey form was reviewed by an academic from the Department of Computer Education and Instructional Technology. Based on the feedback, questions under the interaction theme were removed, and the study continued under four main headings. The interviews were conducted during the fall semester of the 2024-2025 academic year, and participants were asked to answer the questions in detailed and lengthy paragraphs. Ethical approvals were obtained prior to the data collection process (Decision No. 17).

Participants

The participants consisted of pre-service teachers selected through purposive sampling. The study was conducted in the faculty of education at a university. A total of 34 pre-service teachers voluntarily participated in the study. The identities of all participants were kept confidential, and pseudonyms such as Beyza and Sena were used. The study included pre-service teachers who were either final-year students or graduates from various disciplines such as philosophy, art design, business, and child development, and who were enrolled in a pedagogical formation certificate program during the fall semester of the 2023-2024 academic year. Among the 34 participants, 27 were women and 7 were men, with ages ranging from 24 to 47. Participants were informed about ethical guidelines and the voluntary participation process. Purposive sampling was used to ensure the inclusion of individuals with diverse academic backgrounds who could provide rich and relevant insights into the research focus.

Data Analysis

Descriptive analysis was employed to analyze the responses to the open-ended questions in this study. During the analysis process, Creswell's (2015) outlined steps -organizing, transcribing, interpreting, and reinterpreting data- were followed. The four main themes identified before the study (clear and explicit information, meaningful exercises, feedback, and motivation) were used as the basis for the analysis. The participants' responses were organized using Microsoft Excel 2016, coded according to these themes, and classified under the relevant themes. To visually distinguish the themes, each was color-coded differently. To enhance the validity of the research, member checking was conducted through interviews with participants. Based on the feedback received, the validity of the themes was ensured, and statements that were misunderstood or needed to be expressed under different themes were excluded from the analysis.

FINDINGS

Most participants believe that AI-supported chatbots are successful in providing clear and accurate information. Nursema emphasized the facilitating effect of AI on accessing information in her comment supporting this view. Nursema stated: *"I think AI-supported chatbots are excellent teachers. They just aren't alive. Thanks to AI, I can prepare excellent slides. I don't get lost in books. I can easily obtain information on the topic I need, and all I need is an internet connection"*. This highlight how AI-supported tools simplify the process of accessing information. Participants generally found AI's ability to present information positive and noted that its quick access to various types of information facilitates students' learning processes. Neslihan, another participant, drew attention to AI's superiority in providing diverse information, describing it as a teacher with every kind of knowledge. She explained her perspective as follows: *"I think AI is a highly capable teacher. It possesses all kinds of knowledge—subject-specific knowledge, technological knowledge, pedagogical knowledge. The best part is that it has permanent knowledge; we humans forget what we learn"*. According to Neslihan, AI is valued as a resource because it acts as a teacher equipped with pedagogical and technological knowledge.

Another participant, Nur, stated that AI-supported chatbots are not only effective in providing information but also successful in producing meaningful content. She elaborated:

"Do you want to prepare lecture notes for your students? Just tell AI the topic, and it will create an excellent cover and content for you, paying attention to principles like coherence, balance, and emphasis. If the generated content is not suitable for the students' level, you can use the 'regenerate' option to have new notes prepared. This way, information can be easily transferred to students' long-term memory".

Nur highlighted the usefulness of AI-supported tools in the process of preparing teaching materials, noting their ability to produce content suitable for students' levels and revise it as needed. These views underscore AI's ability to automate and personalize teaching materials, making it a valuable aid for teachers in the instructional process.

Some participants also emphasized the effectiveness of chatbots in providing instant feedback. Yaren highlighted the cognitive load-reducing aspect of AI in this regard, stating:

"Its ability to answer all my questions instantly shows that it can be less cognitively demanding than a teacher. It has access to digital information on various topics. I use ChatGPT for many of my assignments and even for ideas I need to consult on. I also know that I can find these answers in its cloud memory when I look back later".

Participants appreciated AI's rapid response capability and noted that it allowed them to complete academic tasks more efficiently. Moreover, AI's ability to provide access to past data was also regarded as a positive feature. Beyza, another participant, described AI as a well-equipped teacher capable of providing feedback, stating:

"AI is so well-equipped that it's like an amazing teacher. Thanks to ChatGPT, lessons can be taught to millions of students simultaneously. At the end of the lesson, it can provide evaluation questions, analyze responses as soon as they are submitted, and generate feedback. Since AI doesn't need to sleep or eat, it can access information anytime. This ability would give it a significant status in education from a student's perspective".

These opinions indicate that participants see AI as having various advantages over human teachers in providing feedback and conducting analyses.

However, some participants expressed concerns about the limitations of AI-supported systems in fostering motivation and enhancing teacher-student interactions. Participants believed that AI cannot provide emotional support, which is intrinsic to human nature. Canan articulated this view, saying:

“There is something that distinguishes robots from humans, and that is emotions. What keeps humans spiritually strong is these emotions. When explaining a topic, looking into a child’s eyes to sense whether they understand and explaining again without hurting them, and seeing their eyes light up when they finally get it—these moments make all the exhaustion worth it. For AI, this may not mean anything, but for me, it’s an invaluable feeling. AI may understand a student who has lost their parent, but it cannot feel it. Saying ‘it will pass’ while patting their back and looking into their eyes creates an unforgettable memory. I don’t think education without emotional support will be beneficial”.

Similar comments reveal participants’ belief in the importance of emotional support in education. Zehra, reflecting on her observations, stated: *“I don’t think schools will end. I believe lessons are more productive when students receive face-to-face instruction in schools, and I have personally experienced this”*. Hakan also emphasized the importance of the human factor, saying:

“Sometimes understanding a student means comprehending all their human aspects, being aware, not judging, and approaching them with empathy. Even if no solution is offered, just feeling understood—the emotional dimension—is what the person really needs. Being human might be too complex for AI”.

Similarly, Senem argued that AI should not replace teachers, stating:

“I believe AI should not be the subject of learning, scientific research, or artistic activities. AI can assist teachers in finding resources. It can enable them to teach lessons more creatively. But it cannot take over the role of a human teacher; it should remain a tool in education and teaching. This is because AI makes mistakes that a human teacher would never make. AI takes its information from the internet or at least from a database whose source is challenging to control. Thus, it presents the information assuming the source is accurate. This can jeopardize a student’s education because, even if the source seems logical, it lacks human reasoning”.

These views reflect the participants’ perspectives that AI-supported systems are valuable as tools in teaching processes but have limitations in supporting teacher-student relationships.

DISCUSSION

Research findings indicate that pre-service teachers have a highly positive outlook on AI-supported educational technologies in many areas. Participants particularly highlighted AI’s success in providing clear and precise information, generating meaningful exercises, and delivering effective feedback. One possible reason for participants’ positive views on AI could be its ability to convey even complex topics in a simple and understandable manner, thanks to its advanced natural language processing capabilities. This allows students to access the information they need quickly and comprehensively. Furthermore, AI-supported tools’ ability to provide personalized exercises suitable for students’ levels enhances the learning process by facilitating a deeper understanding of concepts. The automatic feedback mechanisms offered by AI make it possible to provide instant responses to students, helping them quickly identify and address their shortcomings. These features position AI as a powerful support tool in students’ educational journeys.

While participants viewed AI as a useful tool in the presentation of information and practice processes, they also emphasized that teachers’ human qualities still play a complementary role, particularly in providing motivation and one-on-one communication with students. These views could be based on several reasons. Since AI systems cannot fully simulate human emotional responses and empathy, they may fall short in enhancing students’ intrinsic motivation. As identified in the findings and supported by similar research (Dai et al., 2023), although AI can provide rapid feedback, delivering this feedback in a way that considers individual needs can be challenging. Therefore, feedback from teachers, who closely monitor students’ developmental processes, may be more effective. Students may find encouragement and motivation from a real teacher more genuine, and they may not establish the same level of trust with AI guidance.

AI can use advanced algorithms to identify areas where students struggle; however, it lacks the intuitive approach of a teacher who can understand students’ concerns and provide moral support when necessary. A long-term relationship with a teacher plays a significant role in keeping students motivated. In contrast, AI cannot form an emotional, long-term bond with students. Teachers can adjust their teaching methods flexibly based on students’ immediate needs, using more engaging and motivational strategies. As highlighted in participants’ views, AI lacks this kind of flexibility. Human teachers serve not only as knowledge providers but also as role models. Students can adopt traits like work discipline and empathy observed in their teachers, whereas AI lacks the capacity to serve as a model. Teachers’ excitement and passion for teaching can be felt by students, positively influencing their motivation. AI systems, on the other hand, cannot convey such emotional reflections. A teacher who notices students losing interest in a topic can try a new approach or offer additional support. AI, usually operating within programmed methods, is limited in this regard. Some students may feel more supported and motivated even through small human interactions, such as a teacher’s physical presence or reassuring gaze. AI cannot provide these nuanced experiences.

Findings from the research reveal that participants were satisfied with AI-supported chatbots' ability to provide clear and precise information. Participants viewed the ability to access information quickly and systematically as one of the chatbots' most significant advantages. For example, Nursema emphasized the convenience and time-saving aspects of AI-supported systems in accessing information. Similarly, Neslihan highlighted the diversity of information that AI can offer. This finding demonstrates the positive impact of technology's ability to present information directly, simply, and understandably on students. This aligns with the results of various studies in literature (Mashinchi, 2024). Participants' positive views on AI technologies for meaningful practice are related to the technology's capability to generate student-appropriate content and support repetition-based learning processes. Nur noted that AI could prepare lesson notes tailored to students' levels, contributing to the retention of knowledge in long-term memory. In this regard, AI offers opportunities to personalize and enrich educational processes compared to traditional methods. This finding is consistent with the results of Mashinchi's (2024) study.

Although opinions under the feedback theme varied, the ability of chatbots to provide immediate and continuous feedback was largely viewed positively. Yaren noted that AI's ability to deliver rapid and accurate answers reduces the cognitive load during learning processes, while Beyza emphasized its capacity to interact with and provide feedback to millions of students simultaneously. Participants indicated that the advantages of AI in feedback processes could positively influence students' learning experiences. This finding aligns with various studies (Dai et al., 2023; Pesce & Blanco, 2024).

However, participants also addressed the limitations of AI-supported chatbots in providing motivation and strengthening human interaction. Canan stated that AI could not replace emotional support, highlighting the importance of teachers' ability to maintain eye contact and provide emotional support during the learning process. Similarly, Zehra and Senem argued that AI could not be as emotionally motivating as a teacher and should remain solely as a tool in education. This finding is consistent with many studies (Sipahioglu, 2024; Tzoneva, 2023; Yiğci et al., 2024). As AI tools advance rapidly, their integration into education appears to require thoughtful oversight. These tools should aim to empower educators and learners rather than replace them.

CONCLUSION AND RECOMMENDATIONS

In future studies, participants from different educational levels could be included to examine the perceptions and impacts of AI-supported educational tools. This would provide more comprehensive data on how the role of AI in education is perceived differently among student and teacher groups.

Experimental applications aimed at enhancing the potential of AI-supported tools to provide motivation and emotional support could be explored. This would allow for the development of recommendations for AI to play a more complementary role in classroom interactions.

Comprehensive studies with pre-service teachers from various countries could be conducted to understand perceptions of AI-supported educational tools in different cultural contexts. The impact of cultural differences on the acceptance and implementation processes of such technological innovations should be investigated.

Quantitative studies could be carried out to examine the impact of the speed and accuracy of AI tools in providing in-class feedback on the learning process. Such studies could determine the relationship between the quality of feedback and learning performance, thereby solidifying the value of AI tools in education.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research.

Funding

The author received no financial support for the research.

Statements of publication ethics

I hereby confirm that this study adheres to ethical standards, with no ethical concerns involved, and that all research and publication ethics have been duly observed.

Researchers' contribution rate

The study was conducted and reported by the researcher himself.

Ethics Committee Approval Information

Approving Committee Name: Bursa Uludag University Social and Human Sciences Publication and Ethics Committee Decision No. 17 Date: 29.11.2024.

REFERENCES

Bettayeb, A. M., Abu Talib, M., Sobhe Altayasinah, A. Z., & Dakalbab, F. (2024). Exploring the impact of ChatGPT: Conversational AI in education. In *Frontiers in Education* 9.1379796. *Frontiers Media SA*. <https://doi.org/10.3389/feduc.2024.1379796>

- Creswell, J. W. (2015). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research Fourth Edition*. Pearson Education
- Dai, W., Lin, J., Jin, F., Li, T., Tsai, Y.S., & Gasevic, D., et al. (2023). Can large language models provide feedback to students? a case study on chatgpt. 2023 IEEE International Conference on Advanced Learning Technologies (ICALT), Orem, UT, USA, 2023, pp. 323-325. <https://doi.org/10.1109/ICALT58122.2023.00100>
- Guan, C., Mou, J. & Jiang, Z. (2020). Artificial intelligence innovation in education: A twentyyear data-driven historical analysis. *International Journal of Innovation Studies*, 4(4), 134-147. <https://doi.org/10.1016/j.ijis.2020.09.001>
- Ouyang, F., Zheng, L. & Jiao, P. (2022). Artificial intelligence in online higher education: A systematic review of empirical research from 2011 to 2020. *Education and Information Technologies*, 27(6), 7893-7925. <https://doi.org/10.1007/s10639-022-10925-9>
- Mashinchi, A. A. (2024). Chatbots as Classroom Assistants: A Qualitative Study on Teachers' Perspectives. *AI and Tech in Behavioral and Social Sciences*, 2(2), 12-19. <https://doi.org/10.61838/kman.aitech.2.2.3>
- Mokmin, N. A. M. & Ibrahim, N. A. (2021). The evaluation of chatbot as a tool for health literacy education among undergraduate students. *Education and Information Technologies*, 26(5), 6033-6049. <https://doi.org/10.1007/s10639-021-10542-y>
- Mustroph, C., & Steinbock, J. (2024). ChatGPT in foreign language education-friend or foe? A quantitative study on pre-service teachers' beliefs. *Technology in Language Teaching & Learning*, 6(1), 1-17. <https://doi.org/10.29140/tltl.v6n1.1133>
- Okonkwo, C. W. & Ade-Ibijola, A. (2021). Chatbots applications in education: A systematic review. *Computers and Education: Artificial Intelligence*, 2, 100033. <https://doi.org/10.1016/j.caeai.2021.100033>
- Perkins, D. (1992). *Smart schools: From training memories to educating minds*. New York: The Free Press.
- Pesce M. A., Blanco D. F. (2024) Perceptions of pre-service teachers on the use of ChatGPT during their training and the future implications for their future role in high schools: A research in progress. *Research Square Case Report*. <https://doi.org/10.21203/rs.3.rs-4542918/v1>
- Sipahioglu, M. (2024). Empowering Teachers With Generative AI Tools and Support. In R. Sharma & A. Bozkurt (Eds.), *Transforming Education With Generative AI: Prompt Engineering and Synthetic Content Creation* (pp. 214-238). IGI Global. <https://doi.org/10.4018/979-8-3693-1351-0.ch011>
- Triberti, S., Di Fuccio, R., Scuotto, C., Marsico, E., & Limone, P. (2024). "Better than my professor?" How to develop artificial intelligence tools for higher education. *Frontiers in Artificial Intelligence*, 7, 1329605. <https://doi.org/10.3389/frai.2024.1329605>
- Wollny, S., Schneider, J., Di Mitri, D., Weidlich, J., Rittberger, M. & Drachsler, H. (2021). Are we there yet? - A systematic literature review on chatbots in education. *Frontiers in Artificial Intelligence*, 4, 654924. <https://doi.org/10.3389/frai.2021.654924>
- Yigci, D., Eryilmaz, M., Yetisen, A. K., Tasoglu, S., & Ozcan, A. (2024). Large Language Model-Based Chatbots in Higher Education. *Advanced Intelligent Systems*, 2400429. <https://doi.org/10.1002/aisy.202400429>
- Yin, R. K. (2014). *Case study research: design and methods (5th ed.)*. SAGE Publications.



| Research Article / Araştırma Makalesi |

The Impact of Web-Based Educational Software on Smoking Addiction: A Study on High School Students' Knowledge and Emotional Development

Web Tabanlı Eğitim Yazılımının Sigara Bağımlılığı Üzerindeki Etkisi: Lise Öğrencilerinin Bilgi ve Duygusal Gelişimleri Üzerine Bir Çalışma¹

Merve ÇETİN¹, Mehmet TEKDAL²

Keywords

1. Cigarette addiction
2. High school students
3. Educational software
4. Fight against addiction

Anahtar Kelimeler

1. Sigara bağımlılığı
2. Lise öğrencileri
3. Eğitim yazılımı
4. Sigara ile mücadele

Received/Başvuru Tarihi
16.01.2024

Accepted / Kabul Tarihi
25.07.2025

Abstract

Purpose: The objective of this study is to investigate the impact of educational software designed to combat smoking addiction on the knowledge levels and positive emotional development of high school students.

Design/Methodology/Approach: The study employed an experimental research model conducted in two 10th-grade classes. Prior to the intervention, a pre-test using the 'For a Smoke-Free Life' scale was administered to each class. The web-based educational software, 'Connect to Life, Not Cigarettes' (CLNC), was presented to the students during two course hours. A post-test was conducted after the presentation using the same scale as the pre-test. The data collected from both tests were analyzed using the SPSS statistical program.

Findings: As a result of this research, it was concluded that CLNC had a positive effect ($z = -4.042, p < .05, r = -0.52$) on the knowledge level, but had no effect ($z = -1.595, p > .05, r = -0.20$) on the mood levels of high school students. However, in the case of gender, while it had a positive effect on both the mood ($z = -2.08, p < .05, r = -0.35$) and knowledge levels ($z = 3.59, p < .05, r = 0.61$) of female students, it did not have any effect ($z = -0.70, p > .05, r = 0.14$) on the mood levels of male students.

Highlights: The findings of the study provided evidence that web-based educational software was partially effective in increasing students' knowledge and mood levels in quitting smoking. Concentrating research on this issue may contribute to the improvement of current understanding.

Öz

Çalışmanın amacı: Bu çalışmanın amacı, sigara bağımlılığıyla mücadele için tasarlanan eğitim yazılımlarının lise öğrencilerinin bilgi düzeylerine ve olumlu duygusal gelişimlerine etkisini araştırmaktır.

Materyal ve Yöntem: Araştırma deneysel araştırma modeli kullanılarak 10. sınıftaki iki sınıfta yürütülmüştür. Deney öncesinde her sınıfa 'Dumansız Bir Yaşam İçin' ölçeği kullanılarak ön test uygulandı. Web tabanlı eğitim yazılımı 'Sigaraya Değil Hayata Bağlan' (SDHB) iki ders saati boyunca öğrencilere sunuldu. Sunumun ardından ön testle aynı ölçek kullanılarak son test uygulandı. Her iki testten elde edilen veriler SPSS istatistik programı kullanılarak analiz edildi.

Bulgular: Bu araştırma sonucunda SDHB'nin lise öğrencilerinin bilgi düzeyine olumlu etki yaptığı ($z = -4.042, p < .05, r = -0.52$) ancak duygudurum düzeylerine etkisinin olmadığı ($z = -1.595, p > .05, r = -0.20$) sonucuna varılmıştır. Ancak cinsiyet durumunda kız öğrencilerin hem duygudurum ($z = -2.08, p < .05, r = -0.35$) hem de bilgi düzeylerine ($z = 3.59, p < .05, r = 0.61$) olumlu etki yaparken, erkek öğrencilerin duygudurum ($z = -0.70, p > .05, r = 0.14$) düzeylerine herhangi bir etkisi olmamıştır.

Önemli Vurgular: Araştırmanın bulguları, web tabanlı eğitim yazılımlarının öğrencilerin sigarayı bırakma konusunda bilgi ve duygudurum düzeylerini artırmada kısmen etkili olduğuna dair kanıt sağladı. Araştırmaların bu konu üzerine yoğunlaştırılması mevcut anlayışın geliştirilmesine katkı sağlayabilir.

¹ This research is derived from the master's thesis of the first author under the supervision of the second author.

² İskenderun Science and Art Center, Hatay, Türkiye; <https://orcid.org/0000-0001-7908-8612>

³ **Corresponded Author**, Çukurova University, Faculty of Education, Department of Computer Education & Instructional Technology, Adana, Türkiye; <https://orcid.org/0000-0001-5429-7709>

Cigarettes are the most commonly used addictive substance worldwide, including in Turkey (Selim & Sülükçüler, 2023). Cigarette addiction affects a significant portion of society, particularly young people (Ertaş et al., 2023). Cigarettes contain over 4,000 harmful chemicals. Cigarette smoke includes harmful chemicals such as nicotine, used in pesticide production; cadmium, used in mobile phone battery charging; methane gas, found in swamps; and ammonia, used in liquid fertilizer production (Korkut & Sevinç, 2021). According to the 2021 Organization for Economic Co-operation and Development (OECD) report, which covered 34 member countries, Turkey has the highest cigarette consumption rate at 28%. In OECD countries, 16.5% of individuals aged 15 and above report smoking daily (*Health Risks - Daily Smokers - OECD Data*, 2021). Data from the Turkish Statistical Institute indicate that the smoking rate among adults over age 15 in Turkey was 26.5% in 2016 and increased to 28% in 2019. Of smokers, 41.3% are male and 14.9% are female (TÜİK, 2020).

In Turkey, stringent tobacco control policies have been implemented to decrease smoking prevalence and protect public health. Since the 2008 indoor smoking ban, measures such as restrictions on tobacco advertising and promotion, increased tax rates, and mandatory graphic health warnings on cigarette packaging have significantly contributed to reducing tobacco consumption (Bilir, 2017). However, smoking remains a significant public health challenge, especially among youth, where usage rates continue to be concerning. Addiction education has gained prominence, with organizations like Yeşilay leading initiatives to raise awareness through school programs and public campaigns. These efforts aim to educate individuals about the health risks of smoking, counteract the tobacco industry's marketing strategies, and support cessation efforts. Nevertheless, the reach and effectiveness of these educational programs, particularly in rural areas, require further enhancement to achieve a comprehensive impact.

Young people may initiate smoking out of curiosity, peer or familial influence, or exposure to social media (Akkuş, 2017). Typically, smoking initiation occurs during high school, with some individuals starting even earlier (Ayten & Güven, 2023). Those who become addicted to cigarettes during their youth often continue smoking into adulthood, thereby increasing their risk of developing smoking-related illnesses later in life (Perinçek & Yağcı, 2022). Therefore, anti-smoking studies are necessary to protect young people from the harms of smoking.

In recent years, the widespread availability of Internet access has made web-based smoking cessation methods increasingly advantageous. Early studies explored diverse approaches to treatment delivery and user behavior. However, these studies often found that websites failed to fully incorporate recommended behavioral treatment elements for smoking cessation. For example, Bock et al. (2008) argued that websites offering direct treatment frequently do not fully implement treatment guidelines and neglect to leverage the interactive and personalized capabilities of the Internet. Consequently, they emphasized the need for further research to understand how to maximize the Internet's interactive potential to achieve and sustain population-based health behavior change.

In later years, a study on web-based tobacco cessation interventions by Taylor et al. (2017) concluded that some Internet-based interventions, especially interactive and tailored interventions, can help achieve smoking cessation in the longer term. Furthermore, as Web-based interventions have become more sophisticated, including better website design and improved functionality, the effectiveness of such interventions on smoking cessation has increased significantly (Graham et al. 2016). On the other hand, a comparison of Web-based cessation interventions with face-to-face counseling and quitline counseling suggests that these different methods have the potential to produce similar cessation outcomes (McCrabb et al. 2019).

Several studies suggest that educational software can positively influence adolescents' attitudes toward smoking and reduce their intentions to smoke. For instance, the Stanford Tobacco Prevention Toolkit study found that exposure to an educational session was associated with reduced intentions to try e-cigarettes among participants (Gaiha et al., 2021). De Graaf et al. (2016) compared the effectiveness of print versus audiovisual smoking education materials for low-educated adolescents in the Netherlands. While both modalities improved negative beliefs about smoking, video-based software led to a more negative attitude toward smoking at follow-up, suggesting that dynamic, audiovisual content may be particularly effective for attitude change. However, Park et al. (2017) noted that although participatory digital media production (e.g., creating anti-smoking videos) decreased intentions to smoke, the effect size was modest, indicating that engagement level may influence outcomes. In contrast, research by Cremers et al. (2015) indicated that web-based, computer-tailored feedback was not effective in altering Dutch adolescents' smoking intentions or behavior compared to providing no information.

Mixed evidence exists regarding the impact of educational software on actual smoking behavior. A meta-analysis by Song and Park (2021) examined the effectiveness of smoking prevention programs for young adolescents, which included web-based interventions. They found that school-based, high-intensity programs were more effective than standalone web-based programs in reducing smoking initiation, suggesting that digital tools may need to be integrated with in-person support for optimal behavioral impact. Similarly, Bashirian et al.'s (2021) study investigated the impact of web-based education on preventing hookah smoking in girls and revealed a potential for reducing smoking rates. Their results highlight the significant role of social influences, such as peer and family norms, in this behavior. However, their intervention did not significantly alter perceived behavioral control, indicating that other factors may also affect hookah smoking.

The effectiveness of educational software is influenced by several mediating factors, including program design, user engagement, and social context. Programs that incorporate theory-based approaches, such as the Theory of Planned Behavior (TPB) or Social Learning Theory, tend to yield stronger outcomes. For example, Lareyre et al. (2020), using TPB constructs, significantly impacted adolescents' attitudes and perceived behavioral control over smoking. Social influences, such as peer and family smoking behaviors, also play a critical role. Sajjadi et al. (2018) found that the quality of a boy's social network influences how family smoking impacts their potential for addiction in Iran. Educational programs tailored to local customs and cultural norms are recommended to address tobacco smoking within families. Furthermore, increased efforts to enhance adolescent mental health are necessary to prevent future substance use.

Based on the reviewed studies, ongoing advances in web technologies and web-based smoking cessation interventions, along with the broad reach and customizability of such technologies, indicate potential for future interventions to significantly improve current outcomes. Within this context, web technology advancements can enhance user experience, streamline content management, better integrate interactive elements, and incorporate diverse media types, such as videos and audio. Furthermore, the increasing prevalence of smartphones facilitates web access anytime and anywhere. Consequently, many websites now employ adaptive design optimized for mobile devices, enabling widespread engagement with target audiences. Overall, evidence suggests that websites incorporating interactive components can effectively support smoking cessation. Therefore, further research is necessary to optimize the effectiveness of web-based smoking cessation interventions using the latest technologies.

Researchers have conducted comparative studies on the effectiveness of web-based software. For instance, Severson et al. (2008) found in a randomized trial of 2,523 adults that participants in an interactive, adapted web-based intervention (Enhanced) had significantly higher smoking cessation rates compared to those in a more linear, text-based website (Basic). Similarly, Danaher et al. (2013) compared the effectiveness of two web-based programs for young people aged 14-25 seeking to quit smoking. While the interactive program showed significantly greater engagement, there was no significant difference in smoking cessation rates between the interactive and text-based programs. Another comparative study by An et al. (2010) examined the effectiveness of four tobacco treatment programs: clinic, work-site, phone, and web-based. However, Hutton et al. (2011) concluded that there is currently insufficient evidence to support the use of web-based interventions for smoking cessation in adults, and the evidence remains inconclusive for college students and adolescents.

Existing web-based smoking cessation studies are outdated and fail to fully utilize new web technologies. The effectiveness of these interventions yields mixed results. Comparative studies suggest that interactive environments in web-based smoking cessation software are effective. Testing the impact of an interactive, effective web-based application utilizing new web technologies will address this gap and contribute to the field. This study investigates the impact of web-based educational software developed to combat smoking addiction on the knowledge and positive emotional development of high school students.

METHOD/MATERIALS

Research Model

An experimental research model with a pretest/posttest single group design was employed to determine the effectiveness of an intervention using a systematic method under specified conditions (Tekin, 2000). This design tested the impact of educational software developed to combat smoking addiction on high school students' knowledge levels and positive emotional development. A measurement tool titled "For a Smoke-Free Life" was used to assess students' knowledge and emotional states regarding cigarette addiction. This scale was administered to all participants in the study group as a pre-test before the intervention and as a post-test after the intervention. The dependent variables were knowledge and mood, while the independent variable was the software.

Working Group and Sample

The study group for this research comprised 10th-grade students attending high schools in Hatay/Turkey. The research sample consisted of 10th-grade students from Abdullah Sayek Anatolian High School, selected from high schools in the Iskenderun district of Hatay province. The study was conducted with two randomly selected 10th-grade classes from this school during the 2021-2022 academic year, totaling 61 participating students. Of these 61 students, 35 were female and 26 were male. Before the study, students were surveyed regarding their smoking history. The data is presented in Table 1. Fifty-one students reported never having smoked, five reported having smoked but quit, four reported smoking without regret, and one reported smoking but wanting to quit. Based on these findings, the majority of students in the study group had never smoked.

The sample size was calculated based on a power analysis using G*Power software, targeting a medium effect size (Cohen's $d = 0.5$, $r = 0.3$), a significance level of $\alpha = 0.05$, and a power of 0.80. This yielded a minimum required sample size of 47 participants. To account for potential attrition, we aimed to recruit a slightly larger sample (Durlak, 2009; Kang, 2021; Verma & Verma, 2020; G*Power, 2024).

Table 1: Distribution of High School Students Participating in the Study by Smoking Status

Smoking Status	Girl	Male	Total
I've never smoked before.	29	22	51
I've smoked before. But then I quit.	2	3	5
I do not smoke. I don't regret it.	3	1	4
I do not smoke. But I want to leave.	1	0	1
Total	35	26	61

Data Collection Tool

The study used the "For a Smoke-Free Life" measurement tool to assess high school students' knowledge and emotional states regarding cigarette addiction. Developed by Büyüköztürk et al. (2019), the tool comprises 17 items and has a validated reliability coefficient of 0.84 using Cronbach's alpha. Of the 17 items, the first 12 measure knowledge, and the remaining 5 measure mood. The knowledge section, consisting of the first 12 items, offers three response options: true, false, and "No idea." Participants select "true" if they believe the statement is correct, "false" if they believe it is incorrect, and "No idea" if they lack the necessary information. Before analysis, correct answers to the 12 knowledge items were coded as 1, while incorrect answers and "No idea" responses were coded as 0. The last five items, which measure emotions, are structured using a five-point Likert scale. Adjective pairs are used to express emotions, and participants indicate their emotions by marking the adjective pair that best describes them. Sample items include: "Cigarettes are the most widely used addictive substance in the world" and "One of the immediate effects of smoking is the slowing of blood flow to the brain."

Procedure

The experimental phase of the research was conducted in two 10th-grade classes. Initially, for each class, the "For a Smoke-Free Life" scale was administered as a pre-test. Subsequently, the CLNC software was presented to the students over two course hours. Following the presentation, the same scale was administered as a post-test. Finally, the data collected from the pre-test and post-test results were analyzed using the SPSS statistical program.

CLNC Software

The CLNC educational software was meticulously developed by the researchers to serve as an engaging and informative tool for high school students regarding the perils of smoking. Recognizing the need for interactive and accessible health education resources, the researchers chose the Xerte platform, as the foundational technology for developing the CLNC. The Xerte's capabilities allowed for the creation of dynamic and user-friendly modules, ensuring that the educational content would capture and maintain the attention of its target audience.

The Xerte offers significant pedagogic advantages by enabling educators to create interactive, accessible, and engaging e-learning materials that promote active learning through diverse templates like quizzes and multimedia activities, catering to various learning styles and fostering deeper understanding. Its HTML5-compliant, accessible design ensures inclusivity for all learners, including those with disabilities, while supporting personalized learning through customizable content and adaptive assessments. Features like immediate feedback, collaborative authoring, and cross-platform compatibility (including offline and LMS integration) enhance formative assessment, learner autonomy, and collaborative learning, aligning with modern educational theories. Additionally, Xerte's open-source nature and reusable learning objects support scalable, sustainable curriculum design, making it a versatile tool for blended and remote education environments (Xerte, 2023).

The purpose of the CLNC software is to inform high school students about the harms of smoking, with the aim of preventing non-smokers from starting and supporting smokers to quit. The software employs methods to aid in smoking cessation. The software contains information on the addictive nature of smoking, harmful chemicals in cigarettes, the negative impact of smoking on human health, passive smoking, changes in the human body after quitting smoking, and methods to quit smoking. The content

is both informative and interactive, allowing users to test their knowledge. The educational software, CLNC, enhances the permanence and interest of the information that students learn.

The primary objective of the CLNC software is twofold: to proactively prevent non-smoking high school students from initiating cigarette use and to provide crucial support and information to students who are already smokers, encouraging them to embark on the journey of quitting. To achieve these goals, the software incorporates various evidence-based methods aimed at facilitating smoking cessation and fostering a comprehensive understanding of the risks associated with tobacco consumption.

The content within the CLNC is structured to deliver a broad spectrum of information related to smoking and its consequences. Key topics addressed include a detailed explanation of the addictive properties inherent in nicotine and cigarette smoking, a comprehensive overview of the numerous harmful chemicals present in cigarettes and their detrimental effects on the human body, an in-depth exploration of the wide-ranging negative impacts of smoking on overall human health, and a clear exposition of the dangers associated with passive smoking, highlighting its risks to non-smokers exposed to secondhand smoke. Furthermore, the software provides encouraging information regarding the positive physiological changes that occur in the human body after an individual quits smoking, underscoring the tangible benefits of cessation. Finally, CLNC offers practical guidance and outlines various methods and resources available to assist smokers in successfully quitting.

The pedagogical approach adopted in the development of CLNC emphasizes a balance between informative content delivery and interactive engagement. The software incorporates features that allow users to actively participate in the learning process, including opportunities to test their comprehension through quizzes and interactive exercises. This interactive element is strategically designed to enhance the permanence of the information acquired by the students and to foster a greater level of interest in the subject matter. By providing a dynamic and engaging learning experience, the CLNC educational software aims to maximize knowledge retention and encourage positive behavioral changes among high school students regarding smoking. Representative examples of the software's interactive pages are available for review, offering insight into its user interface and content presentation. Figures 1 through 4 provide sample screenshots of the software.

SİĞARANIN NEDEN OLDUĞU HASTALIKLARI İLGİLİ ORGANLARLA EŞLEŞTİRİNİZ.

Aşağıda sigaranın neden olduğu hastalıklar bulunmaktadır. Bu hastalıkları sürükleyerek resimde bulunan organlarla eşleştiriniz.

Mide-bağırsak sistemini düzenleyen hücrelere verir.

Beyinde felç ve ileri yaşlarda bunama (Alzheimer) görülebilir.

Mide ve yemek borusunda kanama, ülser ve kanser görülebilir.

Gırtlak ve nefes borusu iltihaplanır ve ses telleri zarar görür.

Akciğer kanseri, Bronşit ve Amfizem gibi hastalıklar görülebilir.

Böbrekteki kanlanmanın azalmasına bağlı olarak

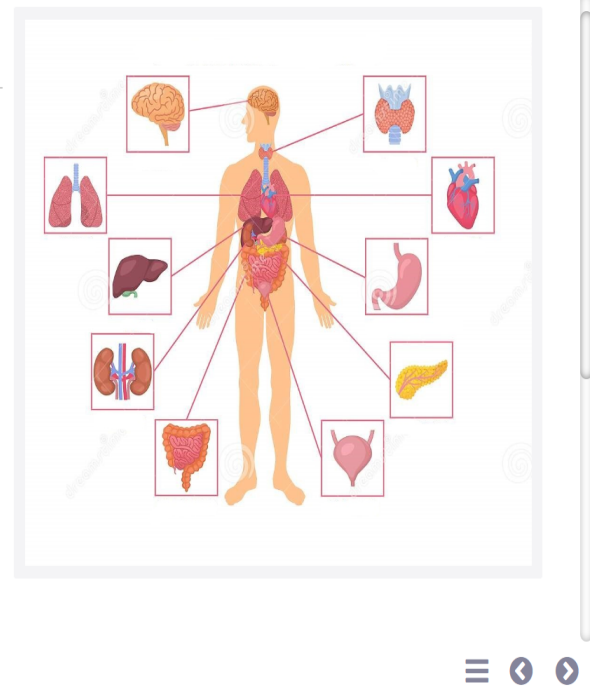


Figure 1: The exercise of matching organs to diseases caused by smoking in CLNC courseware

SİGARA BIRAKIRKEN YAŞANAN ZORLUKLAR

Sigara bırakma sürecinde nikotin vücuttan uzaklaşırken bazı fiziksel belirtiler görülebilir. Nikotinin vücuttan uzaklaşması genellikle son içilen sigaranın ardından başlar ve iki ila üç gün sonra zirve yapar. Bu belirtiler can sıkıcı olabilir ama birkaç hafta içinde azalarak kaybolur.

En çok rastlanan Nikotin yoksunluğu belirtileri

1. Sigara içme isteği
2. Öfke ve huzursuzluk
3. İştah artışı
4. Baş ağrısı
5. Uykusuzluk
6. Titreme
7. Artan öksürük
8. Konsantrasyon bozukluğu
9. Depresyon

100% TAMAMLANDI

Figure 2: Visual describing the difficulties experienced in quitting smoking in the CLNC curriculum

SİGARAYI BIRAKINCA VÜCUDUMUZDA NELER DEĞİŞİR?

Sigarayı bıraktığınızda vücudumuzda olacak değişiklikleri sürükleyerek zaman aralıkları ile eşleştiriniz.

8 SAAT SONRA Kandaki karbonmonoksit miktarı azalır, oksijen miktarı artar. ✓	2-12 HAFTA SONRA Kan dolaşımı daha sağlıklı olur. Yürürken ve koşarken oluşan tıkanmalar azalır. ✓	48 SAAT SONRA Nefes alıp vermek kolaylaşır. Vücutun enerjisi artar. ✗	72 SAAT SONRA Vücuttaki nikotin miktarı normal düzeyde olur. ✗
3-9 AY SONRA Öksürük ve hırıltı azalır. Nefes alma sorunları iyileşir. ✓	1 YIL SONRA Beyin felci riski büyük oranda azalır. ✗	5 YIL SONRA Kalp hastalıklarına yakalanma riski yarıya düşer. ✗	10 YIL SONRA Akciğer kanseri riski büyük oranda azalır. ✓

8 üzerinden 4 puan aldınız.

Cevapları Kontrol Et

100% TAMAMLANDI

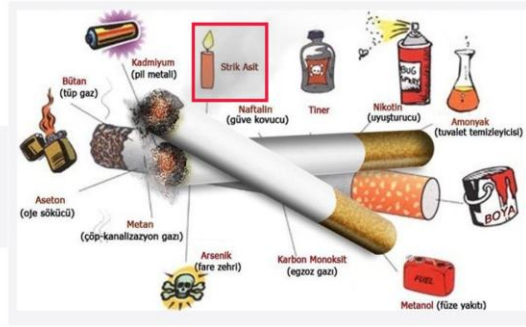
Figure 3: The exercise of matching the changes that will occur in our body when we quit smoking in the CLNC educational software to the time intervals

SİGARADA BİRÇOK ZARARLI KİMYASAL MADDE BULUNUR.

Sigarada 4 binden fazla zararlı kimyasal bulunur. Bu kimyasal maddelerden bazıları yan tarafta gösterilmiştir. Kimyasal maddelerin üzerine tıklayarak ayrıntılı bilgi sahibi olabilirsiniz.

Sitrik Asit

Alkolstüz içecekler ve şekerlerde tat verici olarak kullanılan bir asit türüdür.



100% TAMAMLANDI



Figure 4 : The visual that gives information about the chemical substances in cigarettes in the CLNC educational software

Analysis of Data

The data collected from the research was analyzed using the SPSS program. The information gathered from the measurement tool, which was used to assess the knowledge and emotional states of high school students regarding cigarette addiction, was entered into the SPSS program and analyzed accordingly. Initially, the Kolmogorov-Smirnov test was conducted to determine whether the data exhibited a normal distribution. The data were found to be non-normally distributed as a result of the test, so non-parametric tests were used. The Wilcoxon Signed Rank Test was used to determine if there was a significant difference between the pre-test and post-test results. Additionally, the r effect size value was used to measure the magnitude of the differences between the pre-test and post-test scores. This value supports the p -value and is interpreted as having a small effect if $r = 0.20$, medium if $r = 0.30$, and large if $r = 0.50$. The effect size r is calculated by dividing the Z statistic by the square root of the sample size (N) ($r = Z/\sqrt{N}$) (Fritz, Morris, & Richler, 2012; Field, 2005).

Effect size is used alongside the p -value because while the p -value indicates whether an observed effect is statistically significant (i.e., unlikely to have occurred by chance), it does not convey the magnitude or practical importance of that effect. Effect size quantifies how large or meaningful the effect is, helping researchers assess its real-world relevance. A statistically significant result can have a very small effect size, especially in large samples, and may not be practically meaningful. Therefore, reporting both p -values and effect sizes provides a more comprehensive understanding of research findings and is recommended by major reporting guidelines (Sullivan & Feinn, 2012).

RESULTS

Normality Test

The t -test, a parametric test, is employed to compare mean scores in related measurements. It assumes that the data follow a normal distribution (Field, 2005; Büyüköztürk, 2002). To verify this assumption for the study data, the Kolmogorov-Smirnov test was applied to the pretest-posttest difference scores, and a normality analysis was conducted. The results are presented in Table 2.

Table 2: Kolmogorov-Smirnov and Shapiro-Wilk Test Results of Mood and Knowledge Scores

	Kolmogorov-Smirnov			Shapiro-Wilk		
	statistic	df	Shallow w.	statistic	df	Shallow.
Mood Test	0.31	61	0.00	0.72	61	0.00
Knowledge Level Test	0.15	61	0.01	0.96	61	0.00

Upon examination of the results, it was found that the difference score between the emotion pretest posttest and knowledge pretest posttest scores had a significant p-value ($p < .05$), indicating that both distributions were non-normal. Therefore, the non-parametric Wilcoxon Signed Rank Test was used for the analysis instead of the paired groups t-test.

Is there a significant difference between Knowledge and Emotion pre-test and post-test scores?

A Wilcoxon Signed Rank Test analysis was conducted to determine whether there was a significant difference in students' knowledge and mood scores before and after the experiment. The results are presented in Table 3 and Table 4. The analysis indicates that there was no significant difference between the scores of the students who participated in the study on the emotion test before and after the experiment ($z = -1.595$, $p > .05$, $r = -0.20$). However, a significant difference was found between the students' knowledge test scores before and after the experiment ($z = -4.042$, $p < 0.05$, $r = -0.52$).

Table 3: Wilcoxon Signed Rank Test Results of Knowledge Scores of High School Students Participating in the Research

Knowledge Test Pre-Test-Post-Test	N	Rank Average	Rank Sum	Z	P
Negative Rank	8	22.94	183.50	-4.04	0.00
Positive Sequence	39	24.22	944.50		
Equal	14				

Table 4: Wilcoxon Signed Rank Test Results of Mood Scores of High School Students Participating in the Study

Mood Test Pre-Test-Post-Test	N	Rank Average	Rank Sum	Z	P
Negative Rank	8	11.81	94.50	-1.59	0.11
Positive Sequence	16	12.84	205.50		
Equal	37				

Considering the rank sums of emotion and knowledge difference scores, it is seen that this difference is in favor of positive ranks, in other words, posttest scores. As a result, it was shown that the program applied to quit smoking had a significant effect on increasing the knowledge level of students on this subject ($r = 0.52$), while it had a lesser effect on their emotions ($r = 0.20$).

Do the mood and knowledge test results of the high school students participating in the research differ according to their gender?

A Wilcoxon Signed Rank Test analysis was conducted to determine whether there was a significant difference between the pre- and post-mood and knowledge test scores of the students who participated in the study, based on their gender. The results are presented in Tables 5, 6, 7, and 8.

Table 5: Wilcoxon Signed Rank Test Results of Mood Scores of Female Students

Mood Test Pre-Test-Post-Test	N	Rank Average	Rank Sum	Z	P
Negative Rank	4	7.00	28.00	-2.08	0.03
Positive Sequence	12	9.00	108.00		
Equal	19				

Upon examining Table 5, a significant difference is observed between the mood scores of female students before and after the experiment ($z = -2.08$, $p < .05$, $r = -0.35$). The rank sums of the pretest and posttest scores indicate that this difference is in favor of positive ranks, i.e., the posttest score. Based on the results, it can be concluded that the smoking cessation program has a significant impact on the emotions of female students, with an effect size above the medium level ($r = 0.35$).

Table 6: Wilcoxon Signed Rank Test Results of Female Students' Knowledge Scores

Knowledge Test Pre-Test-Post-Test		Rank Average	Rank Sum	Z	P
Negative Rank	3	13.33	40	-3.59	0.00
Positive Sequence	24	14.08	338		
Equal	8				

Table 6 shows that there is a significant difference between the knowledge scores of female students before and after the experiment ($z = -3.59$, $p < .05$, $r = 0.61$). Considering the rank sums of the difference scores, it is seen that this difference is in favor of the positive ranks, that is, the posttest score. According to this result, it can be said that the smoking cessation program has a significant effect on increasing the knowledge scores of female students, and this effect is quite large ($r = 0.61$).

Table 7: Wilcoxon Signed Rank Test Results of Male Students' Mood Scores

Mood Test Pre-Test-Post-Test	N	Rank Average	Rank Sum	Z	P
Negative Rank	4	4.63	18.50	-0.70	0.94
Positive Sequence	4	4.38	17.50		
Equal	18				

Table 7 shows that there is no significant difference between the mood scores of male students before and after the experiment ($z = -0.70$, $p > .05$, $r = 0.14$). Based on the rank totals of the mood pretest and posttest scores, it is evident that the difference favours the negative ranks, i.e., the pretest score. Therefore, it can be concluded that the smoking cessation program had an insignificant effect on the emotions of male students, with a very low effect size ($r = 0.14$).

Table 8: Wilcoxon Signed Rank Test Results of Male Students' Knowledge Scores

Knowledge Test Pre-Test-Post-Test	N	Rank Average	Rank Sum	Z	P
Negative Rank	5	10.40	52	-1.98	0.47
Positive Sequence	15	10.53	158		
Equal	6				

Table 8 shows that there is no significant difference between male students' knowledge scores before and after the experiment ($z = -1.99$, $p > .05$, $r = 0.39$). Based on the rank sums of the difference scores, it is evident that the positive ranks, i.e., the posttest scores, are higher. This result suggests that the smoking cessation program has a positive effect on increasing the knowledge scores of male students. However, this effect is not statistically significant.

DISCUSSION

This study evaluated the effects of the web-based educational software CLNC on 10th-grade students' knowledge and mood levels related to cigarette addiction, as measured by the 'For a Smoke-Free Life' tool. This section compares and evaluates the data obtained from the research with similar studies in the literature. The research concluded that the educational software named CLNC had a positive effect on the knowledge level of high school students. The findings indicate that a brief, two-hour intervention significantly improved knowledge about smoking risks across all 61 participants, aligning with prior research on technology-based anti-smoking interventions for adolescents (Bashirian et al., 2021; Gaiha et al., 2021). The effectiveness of CLNC in enhancing knowledge supports the use of web-based platforms for delivering concise, scalable tobacco prevention education, particularly for 10th graders, a critical age group for preventing smoking initiation (Song & Park, 2021). The brevity and accessibility of CLNC make it a practical tool for integration into high school health curricula, especially in resource-limited settings where time-efficient interventions are essential.

Several other studies have also found results consistent with this study. For example, Doğan and Ulukol (2010) conducted a study on the effect of an anti-smoking education model on the smoking status and knowledge level of high school students, and reached a similar conclusion. They reveal that the implementation of an anti-smoking education program in schools would impact the smoking status and knowledge level of adolescents. Graham et al., in 2016, examined the effectiveness of web-based smoking cessation interventions in their research, which included randomized trials published from January 1990 to April 2015. They found that web-based applications that include smoking cessation exercises, self-assessment, games and online social interaction are effective in helping people quit smoking. In addition, based on meta-analysis by McCrabb et al. (2019) they argues that internet-based programs increased smoking cessation by an average of 29% in the short term (less than 6 months) and by an average of 19% in the long term (6 months or more). When web-based studies in the literature on cigarette addiction are examined, it is seen that many studies target adults who are addicted to cigarettes or that anti-smoking interventions for adolescents and children provide information about the harms of smoking. In this research, a comprehensive study was conducted for high school students by providing information about both the harms of smoking and techniques to help quit smoking with educational software, and smoking addiction was examined in a different dimension than other studies in the literature.

Surprisingly, as a result of the research, the educational software named CLNC had a positive effect on the mood levels of high school female students. However, it did not have any effect on the mood levels of male students. Considering the entire study group, it was concluded that the educational software named CLNC had no effect on the mood levels of high school students. Öztürk et al. reached a similar conclusion in a study they conducted in 2020. The effects of the Turkey's Addiction Struggle Program implemented by the Counselors in schools on the students' knowledge and emotional states of alcohol, tobacco, substance and technology addiction were examined. As a result of the research, it was determined that the Turkish Addiction Prevention Program showed positive progress in the knowledge and emotional states of the primary school students, but the students at the secondary and high school level showed a positive progress only in the knowledge dimension. Bektaş and Öztürk reached a similar conclusion in a study they conducted with primary school students in 2012. They developed a smoking prevention program for primary school students and evaluated the effectiveness of this program. As a result of the research, it was determined that the students had more information about the harms of smoking, but the rate of trying to smoke did not change.

This key finding on the gender-specific effect on mood also aligns with studies suggesting that female adolescents may respond more positively to emotionally engaging or narrative-driven health interventions (De Graaf et al., 2016). The mood enhancement in female students could be linked to CLNC's web-based format, which may incorporate interactive or relatable content that resonates more with female participants, potentially due to gendered differences in emotional processing or engagement with health messages (Park et al., 2017). Conversely, the lack of mood improvement in male students suggests that gender moderates the emotional impact of CLNC, consistent with research highlighting differential responses to health interventions based on gender-specific socialization or emotional expression norms (Sajjadi et al., 2018). This discrepancy underscores the need to explore how intervention design influences emotional outcomes across genders.

Gender roles may be the reason why this study had a positive effect on both the knowledge and mood levels of female students, while it was not effective on either the knowledge level or the mood level of male students. According to their gender roles, girls are raised to obey the rules and show their feelings, while boys are raised to be independent, strong and not show their feelings (Saygan & Uludağlı, 2021). According to social norms; Men are asked to answer each question correctly and make wise decisions. This norm causes men to not readily accept what they do not know. Also, men are not allowed to live and express their feelings much by society. When they express their feelings, they worry that they will be perceived as weak and they will not be respected (Demirel, 2016). In this study conducted in accordance with these social norms, male students, ignoring the information explained during the research process, assuming their answers to the pre-test are correct, and marking them again while answering the post-test, they may have hidden their true feelings or expressed them differently. In order for this study to be

effective on male students, it is necessary to change the perception of gender. It is imperative for men to recognize that the articulation of their emotions does not denote vulnerability and to acknowledge areas of limited knowledge.

Theoretically, these findings contribute to the Theory of Planned Behavior (TPB), which posits that knowledge and attitudes shape health-related intentions and behaviors (Lareyre et al., 2020). The significant increase in knowledge scores suggests that CLNC effectively enhances students' perceived risks of smoking, a key TPB construct, potentially influencing their intentions to avoid tobacco use. The gender-specific mood effect adds to the literature on tailored interventions, indicating that emotional outcomes may depend on alignment with adolescents' gender-specific needs or preferences (Bashirian et al., 2021). Practically, the results support the adoption of CLNC in 10th-grade health education programs to improve knowledge about cigarette addiction, with particular benefits for female students who experience both cognitive and emotional gains. For male students, schools may need to combine CLNC with supplementary strategies, such as participatory video production or peer-led discussions, to address emotional well-being alongside knowledge acquisition (Park et al., 2017).

CONCLUSION LIMITATIONS AND RECOMMENDATIONS

In conclusion, the CLNC web-based intervention is an effective tool for improving 10th-grade students' knowledge about cigarette addiction, with additional mood benefits for female students. These findings highlight the potential of brief, technology-based interventions in adolescent tobacco prevention while emphasizing the need for gender-sensitive approaches to maximize emotional outcomes. Schools and public health practitioners should consider integrating CLNC into health education programs, while policymakers could leverage its scalability to support national anti-smoking initiatives. Future research should refine CLNC's design and application to ensure equitable benefits for all students, contributing to comprehensive tobacco prevention strategies.

In this study, a single-group pretest/posttest experimental research design was used. The most important threat in this design is the long time between the pretest and the posttest and the use of a less reliable measurement tool (McMillan & Schumacher, 1997). In this context, the time between the pretest and the posttest was kept short and a reliable measurement tool was used. However, this can be seen as two limitations of the study.

One of these limitations is that only because one group intervention method was tested on the knowledge levels and positive emotion development of high school students, other factors that possibly contributed to the decrease of smoking addiction still remain a possibility. To strengthen the evidence base for effective interventions, future research should incorporate control groups that do not receive the tested intervention. This would allow researchers to isolate the specific impact of the intervention by comparing outcomes between the intervention group and the control group, thereby accounting for the influence of extraneous variables. Furthermore, future studies could explore and compare the effectiveness of multiple intervention methods simultaneously, providing a more comprehensive understanding of the most impactful approaches to combating smoking addiction among adolescents.

Another limitation of this study is the short duration of the intervention. In this context, future studies include longitudinal follow-up (e.g., 1-month and 3-month post-intervention assessments) to better assess the long-term impact of the intervention. Investigating the long-term effects of such interventions and exploring the mediating factors that contribute to their success would also be valuable for developing sustainable and evidence-based prevention strategies.

Based on the findings of this study, the following suggestions are recommended for future studies: (1) In a study conducted by Emekdar et al. in 2017, it was determined that while the smoking rate of secondary school students was 17.3% in boys and 4% in girls, a total of 10.3%, this rate increased to 22% in total, 29.9% in boys and 7.1% in girls. In order to make more effective studies on smoking addiction and to prevent young people from starting smoking, studies on smoking addiction should be conducted not only for high school students but also for secondary school students, and these studies should be repeated from time to time., (2) When investigating the effectiveness of studies against smoking addiction, students from all high school types and all grade levels should be included in the study group. As a result of a study conducted by Kurtuluş et al. in 2016, it was stated that smoking habits of adolescents vary according to high school type, age and class level., (3) In order for the studies to be carried out against smoking addiction to be effective on male students as well, gender perceptions such as the fact that men's expressing their feelings are a sign of weakness and that they cannot easily accept what they do not know should be changed. To change gender perceptions schools can implement practices that promote emotional literacy, challenge stereotypes, and provide positive male role models. This includes integrating emotional education into the curriculum, offering peer support groups, using media and open discussions to question traditional masculinity norms, and training teachers and parents to reinforce healthy behaviors., (4) In order to protect students against smoking addiction, support from their families should be sought. The families of the students can be included in the study group of the research to be conducted. Particularly, the support of families should be sought in studies to be carried out on cigarette addicted students. In the development of emotion regulation skills of adolescents; The safe environment provided by families and their positive approach to their children's emotions have a significant impact (Atalar & Atalay, 2018)., and (5) A safe environment should be created so that students can answer the questions in the questionnaire correctly. Especially, smoking students can hide their smoking because they doubt the confidentiality of their answers.

IMPLICATIONS

The findings indicate that the web-based CLNC software, delivered in just two course hours, significantly enhances 10th-grade students' knowledge about smoking risks, making it a practical and scalable tool for high school health education. For female students (n=35), CLNC also improves mood, suggesting its potential as a dual-purpose intervention to support both academic and emotional outcomes in this group. However, the lack of mood improvement among male students (n=26) underscores the need for gender-sensitive approaches in health education. These results contribute to health behavior theories by demonstrating the efficacy of brief, web-based interventions for knowledge acquisition and highlight gender differences in emotional responses to such programs. Schools should integrate CLNC into 10th-grade curricula to bolster anti-smoking education, particularly for female students, while exploring supplementary interventions for male students' emotional well-being. Future research should investigate the mechanisms behind CLNC's gender-specific mood effects and assess its long-term impact on smoking behaviors. Policymakers could leverage these findings to promote CLNC in national tobacco prevention strategies, ensuring equitable health education for all adolescents.

Declaration of Conflicting Interests

The authors declare that there is no conflict of interest with any institution or person within the scope of the study.

Funding

The author(s) received no financial support for the research, author-ship, and/or publication of this article.

Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The authors contributed equally to all processes of the article. The authors have read and approved the final version of the article.

Ethics Committee Approval Information

The authors declare that the work is written with due consideration of ethical standards. The study was conducted in accordance with the ethical principles approved by the Ethics Committee of Çukurova University Social Science Institution (Protocol No. 15 of 22.11.2021-E.246410).

REFERENCES

- Akkuş, D., Karaca, A., Şener, D. K., & Ankaralı, H. (2017, January 3). Lise Öğrencileri Arasında Sigara, Alkol Kullanım Sıklığı Ve Etkileyen Faktörler. *Anadolu Kliniği Tıp Bilimleri Dergisi*, 22(1), 36–36. <https://doi.org/10.21673/anadoluklin.245632>
- An, L. C., Betzner, A., Schillo, B., Luxenberg, M. G., Christenson, M., Wendling, A., Saul, J. E., & Kavanaugh, A. (2010, August 16). The comparative effectiveness of clinic, work-site, phone, and Web-based tobacco treatment programs. *Nicotine & Tobacco Research*, 12(10), 989–996. <https://doi.org/10.1093/ntr/ntq133>
- Atalar, D. S., & Atalay, A. A. (2018). Ergenlik döneminde duygu düzenleme ve ruh sağlığı: Ana-babanın ve mizacın rolü. *Bildik, T., editör. Ergenlik Dönemi ve Ruhsal Bozukluklar. Ankara: Türkiye Klinikleri*, 84-90.
- Ayten, A., & Güven, Ö. F. (2023). Sigara İçme Arzusu ve Dindarlık İlişkisinde Genel Öz-Yeterliğin Aracı Rolünün İncelenmesi: Lise Öğrencileri Üzerine Nicel Bir Araştırma. *İlahiyat Tetkikleri Dergisi*, (59), 71-81.
- Bashirian, S., Barati, M., Karami, M., Hamzeh, B., & Ezati, E. (2021). The Effect of a Web-based Educational Program on Perevention of Hookah Smoking among Adolescent Girls: Application of Theory of Planned Behavior. *PubMed*, 13(4), 259–267. <https://doi.org/10.22122/ahj.v13i4.1154>
- Bektaş, M., & Öztürk, C. (2012). Sigara kullanımı önleme programının geliştirilmesi ve programın etkinliğinin değerlendirilmesi. *Dokuz Eylül Üniversitesi Buca Eğitim Fakültesi Dergisi*, 4(34), 1-21.
- Bilir, N. (2017). Framework Convention on Tobacco Control and Turkey: an example of success. *Güncel Göğüs Hastalıkları Serisi*, 4(1), 7–12. <https://doi.org/10.5152/gghs.2016.001>
- Bock, B. C., Graham, A. L., Whiteley, J. A., & Stoddard, J. L. (2008, November 6). A Review of Web-Assisted Tobacco Interventions (WATIs). *Journal of Medical Internet Research*, 10(5), e39. <https://doi.org/10.2196/jmir.989>
- Büyüköztürk, Ş. (2002). Sosyal Bilimler İçin Veri Analizi El Kitabı: İstatistik, Araştırma Deseni, SPSS Uygulamaları ve Yorum, Pegem Yayıncılık, Ankara.
- Büyüköztürk, E., Yılmaz, S., Özbay, Y., Eşici, H., Tomar, S. H., Aliyev, R., Yıldırım Hoş, H., Şenferah, S., Uysal Saraç, M., Ceyhan, G., & Akyılmaz, F. D. (2019, April 11). The Effectiveness of Addiction Prevention Training Program of Turkey on Improved Acquisition of Knowledge and

- Emotional Awareness about Addiction. *Addicta: The Turkish Journal on Addictions*, 6(1), 115–131. <https://doi.org/10.15805/addicta.2019.6.1.0005>
- Cremers, H., Mercken, L., Candel, M., De Vries, H., & Oenema, A. (2015). A Web-Based, Computer-Tailored smoking Prevention program to prevent children from starting to smoke after transferring to secondary school: randomized controlled trial. *Journal of Medical Internet Research*, 17(3), e59. <https://doi.org/10.2196/jmir.3794>
- Danaher, B. G., Severson, H. H., Andrews, J. A., Tyler, M. S., Lichtenstein, E., Woolley, T. G., & Seeley, J. R. (2013, February 14). Randomized Controlled Trial of MyLastDip: A Web-Based Smokeless Tobacco Cessation Program for Chewers Ages 14-25. *Nicotine & Tobacco Research*, 15(9), 1502–1510. <https://doi.org/10.1093/ntr/ntt006>
- De Graaf, A., Van Den Putte, B., Zebregs, S., Lammers, J., & Neijens, P. (2016). Smoking Education for Low-Educated Adolescents. *Health Promotion Practice*, 17(6), 853–861. <https://doi.org/10.1177/1524839916660525>
- Demirel, G. (2016). Toplumsal cinsiyet mağduriyetinde erkek. In *1st International Scientific Researches Congress Humanit and Social Sciences* (pp. 254-264).
- Doğan, D. G., & Ulukol, B. (2010). Ergenlerin sigara içmesini etkileyen faktörler ve sigara karşıtı iki eğitim modelinin etkinliği. *Journal of Turgut Ozal Medical Center*, 17(3), 179-185.
- Durlak, J. A. (2009). How to select, Calculate, and interpret effect sizes. *Journal of Pediatric Psychology*, 34(9), 917–928. <https://doi.org/10.1093/jpepsy/jsp004>
- Emekdar, G., Çıtıl, R., & Önder, Y. (2017). Tokat İli Ortaokul ve Lise Öğrencilerinde Sigara İçme Prevalansı ve Etkileyen Faktörler. *Journal of Contemporary Medicine*, 1. <https://doi.org/10.16899/gopctd.286207>
- Ertaş, H., Demirhan, N., Başol, E., Temel, E., & Kaya, A. (2023). Bireylerin Sağlık Bilgi Düzeylerinin Sigarayı Bırakma Davranışı Üzerine Etkisinin İncelenmesi. *International Journal of Academic Value Studies (Javstudies JAVS)*, 1(1), 74–82. <https://doi.org/10.29228/jav.67268>
- Field, A. (2005). *Discovering statistics using SPSS* (2nd edition). London: Sage.
- Fritz, C. O., Morris, P. E., & Richler, J. J. (2012). Effect size estimates: Current use, calculations, and interpretation. *Journal of Experimental Psychology: General*, 141(1), 2–18. <https://doi.org/10.1037/a0024338>
- Gaiha, S. M., Zorrilla, M., Sachnoff, I., Smuin, S., Lazaro, A., Ceballos, R. D., Razo, A., & Halpern-Felsher, B. (2021). Development and Reach of the Stanford Tobacco Prevention Toolkit: Implementation of a Community-Based Participatory Approach. *Journal of School Health*, 91(10), 813–824. <https://doi.org/10.1111/josh.13074>
- G*Power. (2024, November 11). <https://www.psychologie.hhu.de/arbeitsgruppen/allgemeine-psychologie-und-arbeitspsychologie/gpower>
- Graham, A., Carpenter, K., Cha, S., Cole, S., Jacobs, M., Raskob, M., & Cole-Lewis, H. (2016, May). Systematic review and meta-analysis of Internet interventions for smoking cessation among adults. *Substance Abuse and Rehabilitation*, 55. <https://doi.org/10.2147/sar.s101660>
- Health risks - Daily smokers - OECD Data. (2021). the OECD. <https://data.oecd.org/healthrisk/daily-smokers.htm>
- Hutton, H. E., Wilson, L. M., Apelberg, B. J., Avila Tang, E., Odelola, O., Bass, E. B., & Chander, G. (2011, February 24). A Systematic Review of Randomized Controlled Trials: Web-Based Interventions for Smoking Cessation Among Adolescents, College Students, and Adults. *Nicotine & Tobacco Research*, 13(4), 227–238. <https://doi.org/10.1093/ntr/ntq252>
- Kang, H. (2021). Sample size determination and power analysis using the G*Power software. *Journal of Educational Evaluation for Health Professions*, 18, 17. <https://doi.org/10.3352/jeehp.2021.18.17>
- Korkut, B., & Sevinç, N. (2021, March 11). Bir Toplum Sağlığı Merkezi Bölgesinde Nikotin Bağımlılığı ve Etkili Faktörler. *SDÜ Tıp Fakültesi Dergisi*, 28(1), 137–143. <https://doi.org/10.17343/sdutfd.804271>
- Kurtuluş, Ö., Kırbaş, Ş., Ferhat, A., İbrahim, G., & Meliha, U. Adölesanların Sigara İçme Alışkanlık Düzeyleri Ve Bunu Etkileyen Faktörlerin Bazı Değişkenlere Göre İncelenmesi. *Kilis 7 Aralık Üniversitesi Beden Eğitimi ve Spor Bilimleri Dergisi*, 1(1), 20-32.
- Lareyre, O., Gourlan, M., Stoebner-Delbarre, A., & Cousson-Gélie, F. (2020). Characteristics and impact of theory of planned behavior interventions on smoking behavior: A systematic review of the literature. *Preventive Medicine*, 143, 106327. <https://doi.org/10.1016/j.ypmed.2020.106327>
- McCrabb, S., Baker, A. L., Attia, J., Skelton, E., Twyman, L., Palazzi, K., McCarter, K., Ku, D., & Bonevski, B. (2018, May 10). Internet-Based Programs Incorporating Behavior Change Techniques Are Associated With Increased Smoking Cessation in the General Population: A Systematic Review and Meta-analysis. *Annals of Behavioral Medicine*, 53(2), 180–195. <https://doi.org/10.1093/abm/kay026>
- McMillan, J. H., & Schumacher, S. (1997). *Research in education: A conceptual framework*. New York: Longman.
- Ozturk, M., Buyukozturk, S., Aydin, G., Dinc, M., Isik, S., Yildirim Hos, H., Uysal Sarac, M., Senferah, S., Ceyhan, G., & Yildirim Seheryeli, M. (2020, September 30). The Effect of Turkish Green Crescent Society APTP Program on Students' Knowledge and Emotional Awareness about Tobacco, Alcohol, Drug, and Technology Addiction. *ADDICTA: The Turkish Journal on Addictions*, 7(3), 180–198. <https://doi.org/10.5152/addicta.2020.20020>
- Park, E., Kulbok, P. A., Keim-Malpass, J., Drake, E., & Kennedy, M. J. (2017). Adolescent Smoking Prevention: Feasibility and Effect of participatory video production. *Journal of Pediatric Nursing*, 36, 197–204. <https://doi.org/10.1016/j.pedn.2017.07.001>
- Perincek, G., & Yağcı, B. (2022, August 31). Sigara bırakma polikliniğine başvuran kişilerde bırakma oranları ile bırakma durumunu etkileyen faktörler. *Mersin Üniversitesi Sağlık Bilimleri Dergisi*, 15(2), 215–224. <https://doi.org/10.26559/mersinsbd.1037222>
- Sajjadi, H., Shushtari, Z. J., Mahboubi, S., Rafiey, H., & Salimi, Y. (2018). Effect of socio-economic status, family smoking and mental health through social network on the substance use potential in adolescents: a mediation analysis. *Public Health*, 157, 14–19. <https://doi.org/10.1016/j.puhe.2018.01.004>

- Saygan, B. B., & PEKEL Uludağlı, N. P. (2021, June 30). Lifespan Development of Gender Roles. *Psikiyatride Güncel Yaklaşımlar*, 13(2), 354–382. <https://doi.org/10.18863/pgy.789615>
- Selim, S., & Sülükçüler, S. (2023, December 29). Duration Analysis of Factors Affecting Smoking Time: A Case Study of Türkiye. *Bağımlılık Dergisi*, 24(4), 475–486. <https://doi.org/10.51982/bagimli.1229787>
- Severson, H., Gordon, J., Danaher, B., & Akers, L. (2008, February). ChewFree.com: Evaluation of a Web-based cessation program for smokeless tobacco users. *Nicotine & Tobacco Research*, 10(2), 381–391. <https://doi.org/10.1080/14622200701824984>
- Song, R., & Park, M. (2021b). Meta-analysis of the effects of smoking prevention programs for young adolescents. *Child Health Nursing Research*, 27(2), 95–110. <https://doi.org/10.4094/chnr.2021.27.2.95>
- Sullivan, G. M., & Feinn, R. (2012). Using effect size—or why the P value is not enough. *Journal of Graduate Medical Education*, 4(3), 279–282. <https://doi.org/10.4300/jgme-d-12-00156.1>
- Taylor, G. M. J., Dalili, M. N., Semwal, M., Civić, M., Sheikh, A., & Car, J. (2017). Internet-based interventions for smoking cessation. *Cochrane Library*, 2017(9). <https://doi.org/10.1002/14651858.cd007078.pub5>
- Tekin, E. (2002). Karşılaştırmalı Tek-Denekli Araştırma Modelleri. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Özel Eğitim Dergisi*, 001–012. https://doi.org/10.1501/ozlegt_0000000049
- TÜİK. (2020, June 4). Türkiye İstatistik Kurumu. Retrieved December 22, 2023, from <https://data.tuik.gov.tr/Bulten/Index?p=Turkey-Health-Survey-2019-33661>
- Verma, J. P., & Verma, P. (2020). Use of G*Power software. In *Springer eBooks* (pp. 55–60). https://doi.org/10.1007/978-981-15-5204-5_5
- Xerte. *Xerte Simple Content Authoring*. <https://www.xerte.org.uk/index.php/en/> Retrieved December 22, 2023.



| Research Article / Araştırma Makalesi |

The Interplay between Assessment Conceptions and Practices of EFL Instructors: A Mixed-method Study

İngilizce Öğretim Görevlilerinin Değerlendirme Kavrayışları ve Uygulamaları Arasındaki İlişki: Bir Karma Desen Araştırması

İrem Aksu Çekiç¹, Müzeyyen Nazlı Güngör²

Keywords

- 1.Assessment conceptions
- 2.Assessment practices
- 3.English language assessment
- 4.EFL instructors

Anahtar Kelimeler

- 1.Değerlendirme kavrayışları
- 2.Değerlendirme uygulamaları
- 3.İngilizce değerlendirme
- 4.İngilizce öğretim görevlileri

Received/Başvuru Tarihi
24.11.2024

Accepted / Kabul Tarihi
25.07.2025

Abstract

Purpose: Teachers' assessment conceptions and beliefs are influential on the assessment practices teachers apply. In that sense, this study aims to explore the interplay between the assessment conceptions of EFL instructors and their self-reported assessment practices.

Design/Methodology/Approach: Data came from 101 EFL instructors working at preparatory schools in Ankara/Türkiye. Quantitative data were collected using the TCoA-III, developed by Brown (2006), while qualitative data were gathered through three semi-structured focus group interview sessions. Descriptive statistics were used to analyse the quantitative data. The qualitative part was analysed through coding by placing the codes under the four pre-determined themes of Brown, which are improvement, school accountability, student accountability, and irrelevance by using MAXQDA. Besides, a self-reflection journal was kept by the researchers to reflect on their opinions and decisions during the data collection and analysis stages.

Findings: The findings of the study pointed that improvement and irrelevance conceptions were the most agreed ones and assessment practices of the EFL instructors in Türkiye vary from Afl tools to AoL tools. The study highlighted some significant implications for assessment component at pre-service curricula, assessment needs of language teachers, and teacher education assessment policy.

Highlights: Instructors are in favour of using a variety of assessment tools. Formative assessment increases student motivation and achievement, which might be the reasons for their favouring Afl tools. Assessment component fails to bridge the theory and practice in pre-service teacher education. This could be solved by making PSTs gain more real-life experiences.

Öz

Çalışmanın amacı: Öğretmenlerin değerlendirme kavrayışları ve inançları, uyguladıkları değerlendirme yöntemleri üzerinde etkili olmaktadır. Bu bağlamda, bu çalışma, İngilizceyi yabancı dil olarak öğreten öğretmenlerin değerlendirme kavrayışları ile kendi bildirdikleri değerlendirme uygulamaları arasındaki etkileşimi incelemeyi amaçlamaktadır.

Materyal ve Yöntem: Veriler, Ankara/Türkiye'de hazırlık okullarında görev yapan 101 İngilizceyi yabancı dil olarak öğreten eğitmenlerden elde edilmiştir. Nicel veriler, Brown (2006) tarafından geliştirilen TCoA-III aracılığıyla toplanırken, nitel veriler üç yarı yapılandırılmış odak grup görüşmesi oturumu yoluyla elde edilmiştir. Çalışmanın nicel kısmını analiz etmek için betimsel istatistikler kullanılmıştır. Nitel kısım ise, MAXQDA yazılımı kullanılarak kodların Brown'un önceden belirlenmiş dört teması (gelişim, okul hesap verebilirliği, öğrenci hesap verebilirliği ve alakasızlık) altında sınıflandırılması yoluyla içerik analiziyle incelenmiştir. Ayrıca, araştırmacılar, veri toplama ve analiz aşamalarında kendi görüş ve kararlarını yansıtmak amacıyla bir öz değerlendirme günlüğü tutmuştur.

Bulgular: Çalışmanın bulguları, gelişim ve alakasızlık kavrayışlarının en çok kabul gören kavrayışlar olduğunu ve Türkiye'deki İngilizceyi yabancı dil olarak öğreten eğitmenlerin değerlendirme uygulamalarının Öğrenme için Değerlendirme (Afl) araçlarından Öğrenmenin Değerlendirilmesi (AoL) araçlarına kadar çeşitlilik gösterdiğini ortaya koymuştur. Çalışma, hizmet öncesi müfredatlarda değerlendirme bileşeni, dil öğretmenlerinin değerlendirme ihtiyaçları ve öğretmen eğitimi değerlendirme politikası konularında önemli çıkarımları vurgulamıştır.

Önemli Vurgular: Eğitmenler, çeşitli değerlendirme araçları kullanmaktan yana bir tutum sergilemektedir. Biçimlendirici değerlendirmenin öğrenci motivasyonunu ve başarısını artırdığı, bu durumun eğitmenlerin Öğrenme için Değerlendirme (Afl) araçlarını tercih etmesinin nedenlerinden biri olabileceği düşünülmektedir. Ancak hizmet öncesi öğretmen eğitimi programlarındaki değerlendirme bileşeni, teori ile uygulama arasındaki bağı kurmada yetersiz kalmaktadır. Bu sorun, öğretmen adaylarının daha fazla gerçek hayat deneyimi kazanmalarının sağlanmasıyla çözülebilir.

¹İzmir University of Economics, School of Foreign Languages, İzmir, Türkiye; <https://orcid.org/0009-0000-2678-8922>

²Corresponding author, Gazi University, Gazi Faculty of Education, Foreign Languages Education Department, ELT Programme, Ankara, Türkiye; <https://orcid.org/0009-0000-2678-8922>

INTRODUCTION

Recent studies on teacher education are concerned with how teachers' histories, beliefs, and conceptions are formed and established, and how knowledge about teaching, learning, and assessment affect their decision-making and classroom practices (Lutovac & Flores, 2022). Conceptions of assessment refer to "one's beliefs, meanings, and understandings of assessment" (Fletcher et al., 2012, p. 120) in this study. Besides, assessment practices are wide and categorised differently in the assessment literature. For instance, in addition to the categorisations, such as formative, summative assessment and traditional, alternative assessment, the terms Assessment as Learning (AaL), Assessment for Learning (AfL), and Assessment of Learning (AoL) were coined as alternatives for summative and formative assessment (Schellekens et al., 2021). These categorisations demonstrate that teachers may favour using different types of assessment practices based on their conceptions and understanding of assessment and that their assessment practices are reflections of their assessment conceptions (Harris & Brown, 2009).

The assessment practices of teachers are the results of the conceptions they own (Harris & Brown, 2009) and their conceptions are formed during their education in teacher education programmes (Kyttälä et al., 2022). This is why it is of paramount importance to understand whether English Language Teaching programmes (ELTEP) provide pre-service teachers (PSTs) with sufficient education concerning assessment and the way these courses shape their assessment conceptions, which might pave the way to reconsider the nature and content of these courses. Finally, it is also crucial to reach an in-depth comprehension of teachers' opinions on assessment practices, which may result in making them more effective institutionally. Besides, in-service teacher education can be prepared considering their assessment conceptions and competencies in that regard.

Considering the importance of assessment as one of the pillars of teaching and learning and teachers' active role in the process, the study aims to explore the interplay between the assessment conceptions of Turkish EFL instructors who work at preparatory schools at tertiary level and teacher assessment practices through the four-facet model developed by Brown (2002, 2004, 2008), and classroom practices to understand the relation between each of these dynamics. Accordingly, the research questions are as follows:

1. What are the assessment conceptions of Turkish EFL instructors in terms of four components defined by Brown (2002, 2004, 2008)?
2. What are the assessment practices that Turkish EFL instructors apply in their institutions?
3. What is the relationship between Turkish EFL instructors' assessment conceptions and the assessment practices they apply?

Theoretical framework

Assessment Conceptions of EFL Teachers

Assessment conceptions are about the beliefs and comprehension teachers have concerning assessment (Lutovac & Flores, 2022). Studies on assessment conceptions revealed many features of assessment conceptions. First, teachers may hold more than one conception, which may even conflict with each other. For instance, Azis (2015) indicates that the conflicting conceptions of teachers are due to their willingness to use process-oriented methods and the requirements of the national exam policy. Second, teachers' experiences as professionals, as well as their own experiences as students may affect their conceptions (Kyttälä et al., 2022). Finally, the influences of culture and the education system on teachers' assessment conceptions are also argued. For instance, Xu and He (2019), whose study led the participants to reflect on their assessment practices, indicated that school assessment culture and already-existing rooted assessment routines, such as being an exam-dominated country, may set limitations on their conception change.

Brown (2002, 2004, 2008) has conducted many studies on assessment conceptions of teachers by proposing a four-facet model and scales to understand assessment conceptions of teachers. Specifically, the Teachers' Conceptions of Assessment Abridged Scale (TCoA-IIIa) (Brown, 2006) was adopted in this study since it was developed later than the full form of the scale and can reach similar information. The four subscales/factors defined by Brown (2002, 2004, 2008) are improvement, school accountability, student accountability, and irrelevance.

Firstly, assessment is seen as positive and constructive in improvement conception since it indicates that assessment is about facilitating student learning with the necessary changes in teaching and providing feedback. Therefore, assessment needs to provide the best information about students' knowledge and be valid and reliable (Brown, 2008; Monteiro et al., 2021). To this end, a variety of assessment tools are used by the teachers having this conception.

Secondly, assessment is seen as a way to demonstrate the success of the teacher, the school, and the country in school accountability conception. Hence, the focus is on the results of assessment (Brown, 2008). Historically, school accountability was valid since students' success was the determinant of the budget provided to schools (William, 2010). Another rationale for school accountability conception is to make positive changes in the teaching quality by ensuring quality institutions and making changes in the teachers' opinions, if necessary.

Thirdly, student accountability conception is about holding students responsible for their learning by checking their performances using a criterion, grading and placing them into different levels/classes, and comparing students' performance with other students (Brown, 2004). Holding students accountable for their learning and performance has some rationales, such as

improving student motivation and penalising the irresponsible ones, as indicated by Kahn (2000). Besides, the popularity of student-centred methods, such as peer assessment and self-assessment also paves the way for student accountability conception (Brown, 2008).

The final conception, irrelevance, points out that teachers' judgements and observations of students are sufficient without formal assessment methods. There might be many reasons for holding this conception. For instance, some teachers may believe that assessment results are ignored, or they do not reflect students' real performance (Brown, 2004). Moreover, the fact that assessments lead to be focused on exams rather than the learning process is another concern, which Berry (2008) calls the negative washback effect. Some of the other reasons are related to perceiving assessment as equivalent to testing, leading to negative emotions (Brown, 2008).

In-service EFL teachers' assessment practices

Teachers' skills and knowledge are highly underlined in the assessment literature as they are responsible for many things from grading exam papers to making decisions on actions that will lead to student success. Therefore, investigating teachers' conceptions and how they put these conceptions into practice is crucial. Supporting this, Popham (2011) points out the positive correlation between teachers' attributing significance to assessment and application of a variety of meaningful classroom practices. Furthermore, the quality of education provided is linked to the quality of teachers (Lutovac & Flores, 2022), suggesting the necessity to consider their educational background since their assessment conceptions and competencies have begun to develop in their pre-service years (Kyttälä et al., 2022). In the Turkish context, English teachers study for four years in ELTEP following a nationwide curriculum, which includes only one course about testing and evaluation throughout the eight-term in a four-year period, which is not sufficient (Güngör & Güngör, 2024). In this vein, teachers' feeling incompetent in assessment has been indicated in some studies, which argue that this lack of competency might be about the content, nature, or delivery of the courses they receive as PSTs. This affects their in-service assessment practices negatively. Moreover, they face some other problems when they start their profession, such as syllabus and time constraints, which limit teachers in putting their assessment literacy into practice (Ogan-Bekiroglu & Suzuk, 2014). In language classes, assessment can occur in distinct forms. Firstly, one of the most popular categorisations is summative and formative assessments. While summative assessment includes scoring and can be seen in the form of final examinations and university entrance examinations, formative assessment is concerned with the learners' progress and efforts to improve the learning process through self-assessment, peer assessment, and portfolios (Schellekens et al., 2021). Teachers prefer both of these assessment methods (Gebiril, 2016), while Kyttälä et al. (2022) claim that formative assessment is gaining more importance.

Secondly, traditional and alternative assessments are investigated in the literature. Traditional assessment methods include true-false and multiple-choice exercises, which are far from being authentic (Nasab, 2015). On the other hand, alternative assessment methods are focused on the higher-level thinking skills of students, together with their problem-solving skills by including real-life contexts, as Norris et al. (1998) address. Therefore, portfolios and projects can be considered as examples of this type.

Lastly, the terms AaL, AfL, and AoL were introduced relatively later than the previous categorisations. AfL is described as a part of a routine of students and teachers for the enhancement of learning through dialogues, observations, and demonstrations (Schellekens et al., 2021). Although AaL is sometimes interpreted as a sub-branch of AfL, Lam (2015) highlights the significant role of the learners and their independence in the assessment process in AaL. The last component of this categorisation is AoL which can be considered in a similar framework as summative assessment since the aim of that type is to provide certifications and reach a conclusion about students, which may be seen in the form of exams (Lee, 2011).

Although a bulk of research on beliefs and conceptions of assessment has been carried out in pre-service and in-service teacher education (DeLuca, et al., 2019), studies on understanding teachers' conceptions of assessment and exploring the relation between these conceptions and their assessment practices are scarce. Teachers may begin their pre-service education with varying levels of assessment knowledge and experience; however, their assessment conceptions and practices may change in their in-service years due to personal, professional, and external political contextual factors (Mockler, 2011). In other words, in-service teachers' conceptions may reflect cultural and societal practices and may be context dependent. Therefore, this study aims to understand EFL instructors' assessment conceptions and practices and explore the interplay between their assessment conceptions and assessment-related practices in the Turkish tertiary education context.

METHOD

Research Context

This study was carried out in preparatory schools of six universities in Ankara/Türkiye. A one-year preparatory school programme is offered to students in higher education to improve their skills in English upon the university entrance and proficiency exams. This practice has been employed in Türkiye since 1958, even though there have been different regulations since then (British Council & TEPAV, 2015). Accordingly, students have to take the proficiency exam at the beginning of the school year, which gives an idea about the English level of the students and decides if a student will be exempted from the preparatory school. At the end of the preparatory school year, students are expected to take a proficiency exam again and they have to study in the

preparatory school one more semester or one more year when they fail. They are expected to pass the proficiency exam by the end of two years. EFL instructors are employed at these preparatory schools to teach English courses after proving their proficiency in the English language (Council of Higher Education, 2016).

Participants

The participants of the quantitative part consisted of one hundred one EFL instructors working at six different preparatory schools in Ankara/Türkiye. They had different educational backgrounds and experience years in teaching English. Table 1 presents the demographic information of the participants.

Table 1. Frequency Distributions of the Participants

How long have you been teaching?	Frequency	Per cent
Less than five years	21	20.8
Between 5-10 years	15	14.9
More than ten years	65	64.4

Which department did you graduate from?	Frequency	Per cent
English Language Teaching	68	67.3
English Language & Literature	23	22.8
Other	10	9.9
Total	101	100.0

Following the quantitative part, nine participants voluntarily agreed to take part in the focus group interview sessions (Table 2).

Table 2. Participants of the Focus Group Interview Part

Participants (Pseudonyms)	Session Number	Years of Experience	Undergraduate Department	Instructor at
Elif	Session 1 (I1)	More than ten years	English Language Teaching	University A
Esra	Session 1 (I1)	Between 5-10 years	English Language & Literature	University A
Leyla	Session 1 (I1)	Less than five years	English Language Teaching	University B
Ekin	Session 2 (I2)	Between 5-10 years	Translation & Interpretation	University A
Melda	Session 2 (I2)	More than ten years	English Language Teaching	University C
Ebru	Session 2 (I2)	More than ten years	English Language Teaching	University D
Hatice	Session 3 (I3)	Less than five years	English Language Teaching	University E
Buket	Session 3 (I3)	More than ten years	English Language Teaching	University C
Songül	Session 3 (I3)	Less than five years	English Language & Literature	University F

Data Collection and Analysis

This study followed a mixed-method research design. The quantitative data came from the 27-item Teachers' Conceptions of Assessment Abridged Scale (TCoA-IIIA) developed by Brown (2006). It was administered to one hundred and one EFL instructors working at six different preparatory schools in Ankara/Türkiye, who were chosen through convenience sampling. The qualitative data was gathered through a focus group interview. It was conducted after the pilot study to gather a more comprehensive understanding of the assessment conceptions of the participants and their opinions on assessment practices. Because the pilot study lasted approximately one hour with two participants, the researchers decided to conduct focus group interviews in three different sessions with three participants in each session. This would lead to gathering of more comprehensive data and lessen the time constraints that would be faced due to including nine participants in one session. The duration of the interview sessions was 72, 59, and 65 minutes, respectively. Finally, a self-reflection journal was kept during the data collection and analysis stages to improve the coding process, ensure triangulation, and present the opinions of the researchers to the readers in an explicit way. One entry from the researcher's self-reflection journal, which was written after the pilot study, is presented below.

"I am happy that my friends could express their opinions without hesitation; however, I have other concerns now. This interview took almost one hour with two participants, so how am I going to include 7-9 participants in the same interview, and

how long will it take? Including a small number of participants may make the discussion more effective [...]” (Aksu Çekiç, 2024, p. 39).

As for the data analysis methods, quantitative data analysis was completed through descriptive statistics. Qualitative data, on the other hand, was analysed through coding (Creswell, 2007). First, the data was transcribed verbatim. Second, some repetitive statements of the participants were coded through MAXQDA, and these codes were placed and explained under the themes of the four-facet model of Brown (2002, 2004, 2008), whose scale was already used in the first step of the study.

Validity and reliability

As the quantitative part of the study was collected via TCoA-IIIA, validity and reliability analysis of the scale was run first. Confirmatory Factor Analysis (CFA) was used to check the validity of the scale. The results revealed that the model was structurally valid, and our data was suitable for the model and the four subscales (fit indices: $\chi^2/df = 2.30 < 5$). However, it should be noted that RMSEA, SRMR, and CFI values were 0.114, 0.136, and 0.680 in the respective order, which was due to the limited sample size and this limitation was noted.

Reliability analysis of the scale was carried out with Cronbach’s Alpha to understand the internal consistency of the scale. The results demonstrated that the overall reliability of the TCoA-IIIA was 0.863, indicating a good internal consistency. The reliability coefficient of the four subscales was also satisfactory with the following scores: 0.790 for school accountability, 0.603 for student accountability, 0.900 for improvement, and 0.749 for irrelevance.

Credibility and trustworthiness

To achieve credibility and trustworthiness, peer review, triangulation, prolonged engagement, and member checking (Creswell, 2007) were ensured in the data collection and analysis phases. First, one of the researchers generated the codes during the data analysis stage. Subsequently, these codes were reviewed by the other researcher to ensure peer review. Second, triangulation was achieved by integrating different data collection tools to have a deeper understanding of the topic. In other words, the researchers integrated a scale, a focus group interview, along with their self-reflection journal. Moreover, prolonged engagement was valid since the researchers had similar backgrounds as the participants and one of them was a member of the investigated community. Lastly, after the coding process ended, one of the focus group participants were asked to check the codes to eliminate any confusion or misunderstandings and ensure credibility and trustworthiness.

FINDINGS AND DISCUSSION

The assessment conceptions of EFL instructors in terms of Brown’s four components

The first research question aimed to understand the assessment conceptions of EFL instructors in terms of Brown’s four components. Descriptive statistics (Table 3) show that the highest mean score belongs to improvement conception ($M=50.73$) and that it is followed by irrelevance conception ($M=30.13$). While student accountability conception has the third highest mean score and agreement level among the participants ($M=12.64$), the mean score of school accountability score is slightly lower with the lowest agreement level ($M=11.55$).

Table 3. Descriptive Statistics Results

Subscales	Minimum	Maximum	Mean	Std. Deviation
Student Acc. Score	6	18	12.64	2.496
School Acc. Score	4	18	11.55	2.837
Irrelevance Score	14	43	30.13	6.876
Improvement Score	22	70	50.73	9.106

Even though descriptive statistics gave a summary of the data gathered via TCoA-IIIA, it was necessary to delve into the opinions of participants on assessment as well as assessment practices. Hence, interview data were analysed and interpreted according to the four factors defined by Brown (2002, 2004, 2008) as predetermined themes (Table 4).

Table 4. Pre-Determined Themes and Codes

Improvement	Irrelevance	Student Accountability	School Accountability
Essentiality	Exams as Inaccurate Indicators of Student Performance	Including Peer Assessment and Self-Assessment	No Direct Link Between Institutional/Teacher Success and Student Success
Assistance for Teachers	National Contextual Factors	Guide for Students	Solutions to Diminish the Feeling of Incompetence
Guidance	Teacher Competencies	Proficiency Exam as a High-Stakes Exam	Washback Effect
Meticulous Design	Ineffectiveness of Pre-Service Assessment Courses	High-Stakes Assessment and Student Emotions	
	Assessment Courses in Shaping Pre-service Teachers’ Mindset		
	Standardisation Problems		

The mean scores of the four subscales indicate that teachers mainly hold improvement conception ($M=50.73$), which is followed by irrelevance conception (30.13). While school accountability conception (11.55) is the least agreed upon by the participants, the difference between student accountability ($M=12.64$) and school accountability is not significant. It was seen that focus group interview sessions supported the findings of the descriptive statistics results. The differences between assessment conceptions depend on many different personal, professional and political factors. Firstly, similar to many other assessment conception studies (Ma & Bui, 2021), the participants in this study mainly have the improvement conception, which indicates that assessment is perceived as a positive factor in improving teaching and learning by reflecting on the existing teaching practices with the help of assessment results. Irrelevance is one of the conceptions with the highest mean score in this study, unlike many other studies (Brown, 2002). These results as well as participants' comments indicated that although teachers believe the significance of assessment based on their personal experiences, some professional or political factors, such as the education system in Türkiye, lead them to have question marks about the quality of assessment. Student accountability conception has the third place in this study, which may relate to the political factors and the fact that students take the English proficiency exam at the end of the year. The final conception in this study is school accountability, following student accountability conception. It demonstrates that even though teachers are aware of the importance of assessment and try to apply it effectively in their classes, their main motivation is not demonstrating their own success or their students' success publicly. These conceptions were explained and exemplified below in order of significance of the findings demonstrating how personal, political, and professional factors affect instructors' opinions and conceptions. Kytälä et al. (2022) describe personal context as teachers' experiences regarding assessment outside of teacher education, while professional factors are described as their experiences throughout their teacher education programme as well as their experiences as teachers. Finally, political factors include the political and societal decisions affecting pre-service teachers' conceptions based on what they are expected to do.

Improvement

Descriptive statistics results revealed that the most agreed assessment conception was improvement. This shows that EFL instructors working at the preparatory schools in the Turkish context are quite aware that assessment holds a significant place in teaching and learning, which might be based on personal or professional factors. In other words, professional factors, such as the theoretical part of their undergraduate courses might have convinced them to think that assessment leads to positive results, although they criticised the practical part of those courses. Supporting this, the researchers identified four beliefs, as revealed by codes within the scope of improvement conception. First of all, the participants believe that assessment is an important component in the language learning process. They also think assessment results help them make decisions about their students and students' needs. Some examples of these beliefs are as below.

For me, assessment is useful for getting feedback from students, especially because you know what is conveyed and what is not conveyed to the students after you assess something. [...] (Essentiality, Ebru-I2)

[...] Assessment not only assesses learners' mechanic knowledge of English but also it should assess pedagogically; maybe learners' needs and how they react to learning a new language in a classroom atmosphere because there are many individual differences when we observe a classroom... So, it not only assesses learners' exam results but also assesses their psychological needs. (Assistance for Teachers, Hatice-I3)

Moreover, participants provided explanations and examples of how they made use of assessment results, indicating that assessment results are a guide for them. Also, they addressed the issue of preparing assessments carefully to attain meaningful results from the assessment, which was indicated by Brown (2008) while explaining improvement conception.

I have an example of that. Once, most of the students in my class were not able to get the difference between "mustn't" and "don't have to." Then, I realised that I must have done something wrong while I was teaching that part, and I went over that one more time for my students. The exam results helped me to understand this. So, of course, we use [assessment] to reflect on our teaching and students' learning. (Guidance, Buket-I3)

Improvement conceptions holding the first place is parallel to the findings of other studies (Pastore & Mincu, 2024) indicating that teachers who work in different contexts, such as the Chinese, Italian, and Turkish contexts relate assessment with improvement regardless of the level that they teach. In other words, the findings of the present study support the other assessment conception studies in which teachers working at primary, secondary and high schools are investigated. This means that there is consistency in assessment culture across different contexts and levels.

Irrelevance

Irrelevance conception had the second highest mean score following improvement conception. It should be underlined that teachers can hold different or conflicting conceptions at the same time (Lutovac & Flores, 2022), which may explain improvement and irrelevance conceptions' having the highest mean scores in this study.

Focus group interview sessions paved the way for us to understand the underlying reasons. First, many participants stated their concerns about the quality of exams. They believed exams were irrelevant and not true indicators of students' performance due to different problems. First, there are problems concerning the preparation stage of the exams. Besides, implementing decontextualised exams, and students' being anxious as a result of taking exams frequently are some of the concerns mentioned by the participants. Additionally, the participants stated that traditional methods of assessment are frequently used in the Turkish education system. They illustrated this issue by providing examples from their personal experiences as students, as well as their

current observations. Buket exemplified her experiences in the third interview, which demonstrated that just having multiple choice exams did not improve her English skills as a high school student.

When I first entered my university, I had 99 correct answers out of 100, and I was not able to speak English. My instructor asked me to introduce myself, and I said I could not speak English, and I thought [it was] okay. As a picture, I was a perfect student, but when I wanted to speak English, I could not. [...] (Exams as Inaccurate Indicators of Student Performance, Buket, I3)

In our Turkish context, assessment is generally seen as something done by the professor or by the teacher, but we do have peer assessment and self-assessment, right? So, we could look at how assessment impacts their learning, maybe from this perspective as well. Generally, [...] if something is not in the test, students generally do not study and pay attention to it. [...] (National Contextual Factors, Melda, I2)

This conflict between the overreliance on the traditional exercises in different countries' education systems and teachers' opposite perspectives is also underlined by Azis (2015). He claims that there is a clash between teachers' willingness to apply process-oriented methods and national assessment policies. Similarly, Tsagari and Vogt (2017) state that the policies of a nation have an impact on teachers' assessment practices. Traces of the Turkish education system could be detected from the participants' words, which exemplifies how political factors might shape or conflict with the assessment conceptions of teachers. For instance, Melda (I2) states that even though she prefers self-assessment or peer assessment, her institution has different policies, which she perceives as the reflection of the assessment perception in Türkiye. Moreover, the criticisms of Buket can be seen below.

[...] I think we lack assessing interaction in most preparatory schools, not only in our school, because we think this is very difficult. [...] So, an addition of paired assessment, group assessment, and assessing the interaction is something that needs to be added in most of the preparatory schools in Türkiye, I think. (National Contextual Factors, Buket-I3)

Moreover, professional factors, such as insufficient pre-service education of teachers, may lead them to think that assessment is irrelevant (Vardar, 2010). In this vein, it is worth noting that although the participants of this study did not consider assessment irrelevant, they had question marks about their assessment competencies. While some of the instructors mentioned that they had to improve themselves concerning in-class assessment, some, on the other hand, focused on the exam preparation part as illustrated below.

[...] I am not good at writing distractors. This is a confession; this is sad, but it is what it is. I am not good at writing distractors, especially in reading. (Teacher Competencies, Ekin-I2)

I feel that I need to learn effective ways of assessing the language skills of our students. (Teacher Competencies, Esra-I1)

Participants' reflections on their competencies concerning assessment addressed the need for in-service training or continuous development programmes in the Turkish context supporting the statements of Larenas and Brunfaut (2023), who highlight the lack of confidence among language teachers concerning assessment. In this regard, the participants criticised the one-term assessment courses in pre-service education since it was not enough to prepare them for real-life contexts, and the content of this assessment-related course/s was not effective in providing them with sufficient training on assessment. Besides, they believed that the course/s could not depict a true picture of what assessment was while shaping their mindset concerning the topic. Similarly, Mertler argues (2003) that teachers' practical experiences are more helpful for them compared to their pre-service education on assessment. The reflections of the researcher written in her self-reflection journal and the participants' words are provided below.

[...] They definitely needed more knowledge when it came to assessment. However, what they really need is practical information about real life, not theories or names, such as formative or summative assessment etc.... What I think is arranging some seminars in relation to real practices, as well as cooperation between teachers would be better [...] (Aksu Çekiç, 2024, pp. 64-65).

[...] Well, I always criticised my university's approach. I learned a lot of things, wrote a lot of research papers, read a lot of articles, etc. [I remember] all the terminology and methodology about teaching, but it is not about real life. The moment I graduated and started working, real life was not like it was given in the books. I always criticise this aspect of my university. But I remember what validity and reliability are about assessment or assessment types: formal assessment, summative assessment... I can list all of them, but in practice, I mean, how to assess during class while a student is speaking, how to assess if he/she is doing well, what aspects should I note down or should I ignore? Nobody told me anything about those. (Ineffectiveness of Pre-Service Assessment Courses, Elif-I1)

Finally, Brown (2008) states the fact that the subjective opinions of teachers are involved while assessing students, which may distort the meaning of the assessment. Concerns about standardisation especially in writing and speaking exams were underlined by the participants of this study in different interview sessions, which is a part of professional and personal factors because their observations as well as their experiences lead teachers to have this conclusion. The participants think that ensuring standardisation while assessing students' language skills, such as writing and speaking skills, is a problem for them. This might lead to these results being evaluated unfairly, paving the way for the irrelevance conception.

[...] The written and the spoken assessments are more likely to be instructors' way of assessing. At that point, I guess there must be a standard for teachers' perspective because I might think of giving a score of 15 for a writing paper, but the same paper can be assessed as 25 [by another instructor.] That is a huge gap between the two instructors, so at that point, there must be a standard, and I do not believe that there is a perfect standardisation for the assessment of writing or spoken exams. [...] (Standardisation Problems, Hatice-I3)

In short, the findings of the study demonstrated participants' concerns about assessment, similar to the ones listed by Brown (2008) while explaining irrelevance conception. These concerns involve exams' not being true indicators of student' performance, their own competencies as teachers, standardisation problems in grading, and the traditional point of view in

assessment, which indicates the adoption of standardised exams. These concerns should be investigated by the institutions and policymakers so that they can be tackled cautiously.

Student accountability

Brown (2008) mentioned that including student-centred methods, such as peer assessment and self-assessment tools for grading purposes is concerned with making students accountable for their learning process. Similarly, the participants mentioned that they utilised peer assessment and self-assessment tools in their assessment practices. Moreover, they believed that students should be reflective and use their assessment results to draw a map for their learning and take the required steps in the learning process as active agents through different practices. Unlike the participants of Tsagari and Vogt's (2017) study, who did not prefer alternative assessment tools, the participants in our study indicated that they preferred AfL practices.

Learners also need to see what they have done and what they could not do on a task, for example, at the end of this assessment. It does not have to be graded or something but in any kind of assessment. That is like a sign for them or a guide for them to see which parts they have learned better or which parts they should improve. [...] They can reflect on their learning if they are clever enough, well, if they are good reflectors, let us say. (Guide for Students, Elif-I1)

Furthermore, students are held accountable for their learning through their performances, and their success is decided based on a criterion or based on other students' performances, leading them to be placed in different classes/schools accordingly, as Brown (2008) explained. This is similar to proficiency exam administration in preparatory schools. Proficiency exams in preparatory schools are the determinants of the students' language levels and they show if students will skip the preparatory school to start their departmental courses. Thus, it is an influential political factor in their conceptions since instructors have to prepare their students for this exam. Some participants mentioned how they used proficiency exam results to put students into different classes. However, they also repeatedly criticised how high-stakes exams, including language proficiency exams, negatively affect students' psychology. Similarly, Harlen and Crick (2003) point out that teacher assessment is less harmful to students' self-efficacy and more motivating for students than high-stakes assessments.

In my institution, we have a slightly different approach. If students cannot reach the goals of a level, we generally use those assessment results and change their level. We kind of demote them to a lower level, and we also use students' successful results and give them another chance to move up one more level [...], so we use assessment results like this in addition to what has been said. (Proficiency Exam as a High-Stakes Exam, Melda-I2)

[...] I think we should make [assessment] a bit more individualistic and softer than what we are doing right now because it makes me sad to see students getting stressed over some useless preposition items in a long phrase that they have to memorise [...] (High-Stakes Assessment and Student Emotions, Songül-I3)

In conclusion, the participants are in favour of holding students accountable through peer assessment and self-assessment methods, and individual guidance. Nevertheless, political factors, such as high-stakes exam context and the observation that students are excessively held accountable for their learning, and they feel under pressure may contribute to teachers' adopting irrelevance conception.

School accountability

School accountability conception suggests that assessment results are a way for schools and teachers to show that they have been successful (Brown, 2008). Therefore, teachers with this conception may point to a direct link between students' success and institutional success or teachers' success. Interview data reveal that participants cannot draw a direct link between student success and teacher/institutional success. However, they hold themselves responsible for student learning and are willing to improve their assessment competencies. Therefore, their opinions and suggestions to overcome the feeling of incompetency were included within the scope of the school accountability conception. Communication and cooperation between teachers were emphasised as significant points in that regard, which is also mentioned by Yan and Fan (2021). The participants in their study also highlighted communication between stakeholders as a neglected point in language testing, which is said to be helpful for them to improve themselves.

I think you can roughly call a teacher successful if a high percentage of students get above a certain grade, but not an institution because institutional practices change quite a lot. [Also,] "successful" in one institution's terms and one institution's assessment criteria might be very unsuccessful in another, but you can say that this teacher has done a good job or a bad job. But I think you have to take care of the fact that certain groups sometimes have certain behavioural issues [...], so you can carefully assess the teacher but not the institution, I think. (No Direct Link Between Institutional/Teacher Success and Student Success, Leyla-I1)

Well, collaboration, I think because we are not alone, as you can see [in the interview.] Everybody has the same problem. I do not want to say, "Okay, let us go and read articles." because I do not find it very practical. However, I think the instructors should come together and do research or share experiences in their institutions. Maybe they can read and research together, especially with the testing and assessment team because we are doing some kind of assessment in the class, and that is fine. (Solutions to Diminish the Feeling of Incompetence, Elif I1)

Brown (2008) mentions that school accountability conception and the emphasis on exams and demonstrating the success of schools/institutions may lead teachers to turn their focus to exam scores and they may begin to "teach to the test", which is coded as the washback effect by the researchers. The participants in this study criticised some of their students as they focused more on the topics and skills that they would encounter in their exams, indicating the negative washback effect, as also acknowledged by Yan et al. (2018). They indicated that the negative washback effect or "teaching to the test" is seen in exam-

oriented countries, such as China where the main purpose of teachers is to prepare their students for the high school entrance exam, which is similar to the Turkish context. Thus, it is of no surprise for students to turn their focus to exams and only study for these exams affecting their future lives.

It may have some positive and negative effects. Well, when I say negative effect, for example, students do not have to pass a speaking test to pass the preparatory school in my institution. Therefore, they want to focus on grammar, vocabulary, and reading more than doing some speaking exercises, [but] it is not learning English. I mean, while learning English, they lack the skill of speaking most of the time just because of that. (Washback Effect, Ebru-12)

In conclusion, the learning environment is sometimes negatively affected by the fact that students' knowledge will be assessed through exams, which may lead students and teachers to focus on exam results, rather than focusing on language learning in general, and it is indicated as a concern by the participants. Furthermore, the findings of the study show that there is not a direct parallelism between student success and teachers'/institutions' success, which means that students' success or failure may depend on many different external factors regardless of how hard teachers or institutions try to fully prepare them for their exams.

Overall, the findings revealed that EFL instructors mainly had improvement conception, which is followed by irrelevance conception since instructors had some concerns about both their competencies and the existing assessment practices in their institutions. The focus was less on the school accountability conception in this study.

EFL instructors' assessment practices in their institutions

The second research question aimed to understand the assessment practices EFL instructors applied in their institutions. The findings are based on participants' self-reported assessment practices. In other words, they were asked the assessment practices they use in their institutions and classes during the interview. The findings revealed that preparatory schools of the six investigated universities employ a variety of assessment practices from AfL to AoL tools. It was found that assessment practices in these six institutions are similar to each other. Ekin gives a detailed description of some assessment practices that take place in her institution. After that, she explains how they deal with the assessment of speaking and writing skills. Furthermore, some in-class assessments are said to be based on teachers' own decisions, rather than their institutions' obligatory practices, although the participants feel like they do have only minor individual choices apart from the institutional assessment policies. Similarly, Troudi et al. (2009), argue that teachers are not involved in the decision-making process of assessment tools. In other words, EFL instructors may not play an active role in the decision-making process of assessment tools or preparation stage of them. Still, they might have some individual choices in class. For example, Esra explains how she gives feedback in class.

Of course, portfolios have some writing and speaking tasks. Writing tasks evolve during the term. For example, [...] we ask questions to describe the process, and it is also a process writing [written in] two drafts. [...] We give feedback, and the student writes and gives us his/her second draft. Then, we give feedback again with his/her grade, and they learn. First, they write something little, and then they write a paragraph. Then, they learn how to write an essay, and from that time, they continue writing several types of essays. In the proficiency exam, they are expected to write a well-developed essay. When it comes to these speaking tasks, they are mostly about real-life issues. They mostly include some role-plays that can be with a partner or alone, and they range from two to four minutes. [...] (Ekin, 12)

In the class, I use peer feedback. For example, they write a paragraph, and I want the students to give feedback to their classmates. [...] I do not use it in speaking because they can be really shy and frustrated, so I do not use that. [...] (Esra, 11)

The participants also indicated that they had some suggestions and criticisms for the existing assessment practices in their institutions to enhance the effectiveness of those practices.

[...] So, some of the practices, unfortunately, are determined by the logistics as well. For example, speaking assessment; we want to do more of it, but we have to do it on a slow scale, not very frequently. This makes the teachers more responsible for evaluating students' speaking skills. [...] (Melda, 12)

I do not think anything should be omitted [from the institutional assessment practices] but added. I think we lack assessing interaction in most preparatory schools, not only in our school, because we think this is very difficult. [...] (Buket, 13)

As a result, it was found that a variety of assessment tools are used in preparatory schools in Ankara/Türkiye, which is similar to the findings of Struyven et al. (2005) who indicate that portfolios, peer assessment and self-assessment tools are applied at tertiary level.

The interplay between EFL instructors' assessment conceptions and their assessment practices

The last research question explored the interplay between EFL instructors' assessment conceptions and assessment practices. Firstly, the findings demonstrated that participants mainly have improvement conception, which is supported by the assessment practices they prefer. The participants are in favour of using a variety of assessment tools, just like mentioned by Troudi et al. (2009). They indicate that different assessment tools should be used so that it can be helpful for students to benefit from assessment. In this vein, it is found that participants in this study use quizzes, peer feedback, games, and group discussions as in-class assessment tools, in line with improvement conception. Besides, the participants also stated that they preferred including AfL tools in their lessons by focusing on students' production, performance, and progress rather than their exam results. As DeLuca et al. (2013) underlined, formative assessment increases student motivation and achievement, which might be the reason for their favouring AfL tools.

Secondly, although the participants of this study did not directly state that assessment is irrelevant, they had some concerns and question marks about the existing assessment practices, which might have resulted in 'irrelevance conception' being the second one in this study. Some criticisms of the participants include traditional assessment methods and inauthentic and decontextualised exams. Teachers' criticisms should be considered so that necessary steps can be taken, and the adoption of irrelevance conception can be decreased. Moreover, some institutional problems, such as the lack of number of teachers and school facilities, negatively influence the effectiveness of assessment practices, as mentioned by the participants, along with some other criticisms and suggestions, which led them to have irrelevance conception to some extent. Furthermore, Brown (2002) indicates that teachers may believe that assessment should be based on teachers' observations rather than standardised assessment tools. While the participants in this study, such as Elif (I1) and Ebru (I2), believe that observations of teachers comprise a significant part of assessment, they still believe that a variety of assessment tools should be adapted to improve student learning.

Thirdly, the participants of this study have student accountability conception, which may, in some aspects, go hand in hand with the improvement conception. Participants' having student accountability conception reflected itself in participants' using peer assessment, self-assessment, and student-centred methods, as well as their willingness to provide students feedback by making them active agents of their learning. Yet, the participants were still aware of the pressure that students feel due to being accountable for their performance in high-stakes exams.

The final conception in this study is school accountability. Since the participants do not mainly prefer showing that they have done a successful job as teachers or demonstrate their institutions' success, they also do not favour high-stakes exams. In other words, the participants have school accountability conception only to a limited extent. Similarly, they do not perceive standardised exams as one of the most significant assessment practices. On the contrary, they prefer including a variety of different assessment tools, which is mainly related to improvement conception.

Overall, this study found that there is a positive correlation between assessment conceptions of the instructors and their preferences concerning assessment practices, which is also claimed by Brown (2008). Even though there is a difference between Brown's research context, which investigated primary and secondary school teachers' assessment conceptions, and this study's context, similar results could still be attained.

CONCLUSION AND RECOMMENDATIONS

This study aimed to explore the interplay between their assessment practices and conceptions regarding personal, professional, and political factors. Implications are suggested for teacher education programmes, effective assessment practices, and transparent assessment policies in language teaching and learning. First, as addressed in instructors' interviews, assessment component fails to bridge the theory and practice in pre-service teacher education (Güngör & Güngör, 2024). This could be solved by making PSTs gain more real-life experiences, as underlined by Güngör and Güngör (2024). Moreover, similar to the suggestion in the study of DeLuca et al. (2013), the participants in this study also shed light on some points to be considered when designing courses for PSTs. These include the necessity of focusing on in-class assessments and giving immediate feedback. Moreover, designing quality exams was a point of concern for the participants as they felt a need to improve themselves in that regard, which needs to be included in the pre-service teacher education. As DeLuca et al. (2013) suggest, when PSTs get the opportunity to improve themselves on assessment, they demonstrate positive results, such as higher levels of perceived confidence and competency.

Second, there is a need to have in-service training and continuous professional development programmes by considering teachers' needs so that improvement conception can be fostered, and irrelevance conception can be decreased (Schellekens et al., 2021). The participants of this study also demonstrate their willingness to participate in these programmes to increase their assessment competency level and to increase the effectiveness of the assessment procedures.

Third, in order to make assessment perceived as less irrelevant, the procedures of designing and implementing high-quality assessments should be dealt with cautiously. In this regard, preparing exams carefully and grading speaking and writing exams in a standardised way should be prioritised so that assessment could be valid and meaningful (British Council & TEPAV, 2015). As the participants indicate, testing units of the preparatory schools have a huge responsibility in these regards, which should be supported by the efforts of teachers.

Fourth, the participants of this study underscored that the primary focus should be including more meaningful and less strict and stressful assessment practices. Furthermore, participants' support for AfL tools manifested itself as supporting peer assessment and self-assessment methods. Moreover, portfolio assessment is favoured by the participants. As indicated by Delett et al. (2008) and supported by our participants, portfolio assessment is helpful in increasing student motivation and encouraging reflection.

Finally, this study found that there are some institutional problems in the Turkish higher education context. Solving institutional problems, such as financial problems or problems regarding the number of instructors, will lead to the effective implementation of assessment practices. Therefore, needs analysis studies can be applied to gain better insights and comprehensive understanding of the problems in different institutions so that solutions can be developed accordingly.

Limitations

This study has some limitations. The researchers intended to reach more participants while collecting quantitative data; however, the number of participants was limited to 101 participants from six preparatory schools. Future studies may reach out to more EFL instructors from various institutions, which will help form a broader perspective of the assessment conceptions of EFL instructors in the Turkish context. These conceptions may be compared and contrasted with those of international EFL/native instructors to reach a sound conclusion. Furthermore, the data gathered regarding the assessment practices of the participants is based on their own reports during the focus group interview sessions. Following studies may include on-site classroom observations to eliminate this limitation, get a better understanding of the topic, and enhance the credibility of the study.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, author-ship, and/or publication of this article.

Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Author contribution statements

The first and second authors conceived of the presented idea. The first author developed the theory and performed the computations. The second author verified the analytical methods. The second author encouraged the first author to investigate mixed-method research design and supervised the findings of this work. All authors discussed the results and contributed to the final manuscript.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

This study was conducted for the first author's master's thesis at Gazi University in Ankara/Türkiye from May 2023 to July 2024 with the approval of Ethics Commission at Gazi University under the supervision of the second author.

REFERENCES

- Aksu Çekiç, İ. (2024). *An investigation into the assessment conceptions of in-service English language instructors* (Publication No. 873387) [Master's thesis, Gazi University] <https://tez.yok.gov.tr>
- Azis, A. (2015). Conceptions and practices of assessment: A case of teachers representing improvement conception. *TEFLIN Journal*, 26(2), 129-154.
- Berry, R. (2008). *Assessment for learning*. Hong Kong: Hong Kong University.
- British Council & TEPAV (2015). *The State of English in Higher Education in Turkey*. Ankara. Retrieved from <https://www.britishcouncil.org.tr/>
- Brown, G. T. L. (2002). *Teachers' conceptions of assessment* (Doctoral dissertation). Retrieved from <https://researchspace.auckland.ac.nz/handle/2292/63>
- Brown, G. T. L. (2004) Teachers' conceptions of assessment: Implications for policy and professional development. *Assessment in Education: Principles, Policy & Practice*, 11(3), 301-318.
- Brown, G. T. L. (2006). Teachers' conceptions of assessment: Validation of an abridged instrument. *Psychological Reports*, 99(1), 166-170.
- Brown, G. T. L. (2008). *Conceptions of assessment: Understanding what assessment means to teachers and students*. New York: Nova Science.
- Council of Higher Education (2016). [Yükseköğretim Kurumlarında Yabancı Dil Öğretimi Ve Yabancı Dille Öğretim Yapılmasında Uyulacak Esaslara İlişkin Yönetmelik]. Official Gazette, Issue: 29662.
- Creswell, J. W. (2007). *Qualitative inquiry & research design: Choosing among five approaches*. The United States of America: SAGE.
- Delett, J. S., Barnhardt, S., & Kevorkian, J. A. (2008). A framework for portfolio assessment in the foreign language classroom. *Foreign Language Annals*, 34(6), 559-568.
- DeLuca, C., Chavez, T., Bellara, A., & Cao, C. (2013). Pedagogies for preservice assessment education: Supporting teacher candidates' assessment literacy development. *The Teacher Educator*, 48(2), 128-142.
- DeLuca, C., Coombs, A., & LaPointe-McEwan, D. (2019). Assessment mindset: Exploring the relationship between teacher mindset and approaches to classroom assessment. *Studies in Educational Evaluation*, 61, 159-169.
- Fletcher, R. B., Meyer, L. H., Anderson, H., Johnston, P., & Rees M. (2012). Faculty and students conceptions of assessment in higher education. *Higher Education*, 64, 119-133.

- Gebril, A. (2016). Language teachers' conceptions of assessment: An Egyptian perspective, *Teacher Development*, 21(1), 81-100.
- Güngör, M. A., & Güngör, M. N. (2024). Relocating assessment in pre-service teacher education: an emerging model from activity theory lens. *European Journal of Teacher Education*, 47(2), 348-368.
- Harlen, W., & Crick, R. D. (2003). Testing and motivation for learning. *Assessment in Education: Principles, Policy & Practice*, 10(2), 169-207.
- Harris, L. R., & Brown, G. T. L. (2009). The complexity of teachers' conceptions of assessment: Tensions between the needs of schools and students. *Assessment in Education: Principles, Policy & Practice*, 16(3), 365-381.
- Kahn, E. A. (2000). A case study of assessment in a grade 10 English course. *The Journal of Educational Research*, 93(5), 276-286.
- Kyttälä, M., Björn, P. M., Rantamäki, M., Lehesvuori, S., Närhi, V., Aro, M., & Lerkkanen, M. K. (2022). Assessment conceptions of Finnish pre-service teachers. *European Journal of Teacher Education*, 1-19.
- Lam, R. (2015). Language assessment training in Hong Kong: Implications for language assessment literacy. *Language Testing*, 32(2), 169-197.
- Larenas, S. V., & Brunfaut T. (2023). But who trains the language teacher educator who trains the language teacher? An empirical investigation of Chilean EFL teacher educators' language assessment literacy. *Language Testing*, 40(3), 463-492.
- Lee, I. (2011). Bringing innovation to EFL writing through a focus on assessment for learning. *Innovation in Language Learning and Teaching*, 5(1), 19-33.
- Lutovac, S., & Flores, M. A. (2022). Conceptions of assessment in pre-service teachers' narratives of students' failure. *Cambridge Journal of Education*, 52(1), 55-71.
- Ma, M., & Bui, G. (2021). Chinese secondary school teachers' conceptions of L2 assessment: A mixed-methods study. *Studies in Second Language Learning and Teaching*, 11(3), 445- 472.
- Mertler, C. A. (2003). *Pre-service versus in-service teachers' assessment literacy: Does classroom experience make a difference?* Paper presented at the Annual Meeting of the Mid-Western Educational Research Association, Columbus. Retrieved from <https://eric.ed.gov/?id=ED482277>
- Mockler, N. (2011). Beyond 'what works': Understanding teacher identity as a practical and political tool. *Teachers and Teaching: Theory and Practice*. Retrieved from <https://www.researchgate.net/>
- Monteiro, V., Mata, L., & Santos, N. N. (2021). Assessment conceptions and practices: Perspectives of primary school teachers and students. *Frontiers in Education*, 6, 1-15.
- Nasab, F. G. (2015). Alternative versus traditional assessment. *Journal of Applied Linguistics and Language Research*, 2(6), 165-178.
- Norris, J. M., Brown, J. D., Hudson, T., & Yoshioka, J. (1998). *Designing second language performance assessments*. University Of Hawaii.
- Ogan-Bekiroglu, F., & Suzuk, E. (2014). Pre-service teachers' assessment literacy and its implementation into practice. *The Curriculum Journal*, 25(3), 344-371.
- Pastore, S., & Mincu, M. (2024). A feasible balance? The Italian teachers' standpoint on assessment literacy, assessment practice, and teacher professional development. *European Journal of Teacher Education*, 1-20.
- Popham, W. J. (2011). Assessment literacy overlooked: A teacher educator's confession. *The Teacher Educator*, 46, 265-273.
- Schellekens, L. H., Bok, H. G. J., Jong, L. H., van der Schaaf, M. F., Kremer, W. D. J., & van der Vleuten, C. P. M. (2021). A scoping review on the notions of assessment as learning (AaL), assessment for learning (AfL), and assessment of learning (AoL). *Studies in Educational Evaluation*, 71, 1-15.
- Struyven, K., Dochy F., & Janssens, S. (2005). Students' perceptions about evaluation and assessment in higher education: A review. *Assessment & Evaluation in Higher Education*, 30(4), 325-341.
- Troudi, S., Coombe, C., Al-Hamly, M. (2009). EFL teachers' views of English language assessment in higher education in the United Arab Emirates and Kuwait. *TESOL Quarterly*, 43(3), 546-555.
- Tsagari, D., & Vogt, K. (2017). Assessment literacy of foreign language teachers around Europe: Research, challenges and future prospects. *Papers in Language Testing and Assessment*, 6(1), 41-63.
- Vardar, E. (2010). *Sixth, seventh and eighth grade teachers' conception of assessment* (Master's thesis). Retrieved from <https://tez.yok.gov.tr/>
- Wiliam, D. (2010). Standardized testing and school accountability. *Educational Psychologist*, 45(2), 107-122.
- Xu, Y., & He, L. (2019). How pre-service teachers' conceptions of assessment change over practicum: Implications for teacher assessment literacy. *Frontiers in Education*, 4, 1-16.
- Yan, X., Zhang, C., & Fan, J. J. (2018). Assessment knowledge is important, but...: How contextual and experiential factors mediate assessment practice and training needs of language teachers. *System*, 74, 158-168.
- Yan, X., & Fan, J. (2021). "Am I qualified to be a language tester?": Understanding the development of language assessment literacy across three stakeholder groups. *Language Testing*, 38(2), 219-246.



Examination of Scale Transformation and Test Equating Methods in Testlet Based Tests

Madde Takımı İçeren Testlerde Ölçek Dönüştürme ve Test Eşitleme Yöntemlerinin İncelenmesi¹

Harun DİLEK², Kübra ATALAY KABASAKAL³, Sebahat GÖREN⁴

Keywords

1. Testlet
2. Testlet effect
3. Test equating
4. Testlet Response Theory

Anahtar Kelimeler

1. Madde takımı
2. Madde takımı etkisi
3. Test eşitleme
4. Madde Takımı Tepki Kuramı

Received/Başvuru Tarihi
25.12.2024

Accepted / Kabul Tarihi
25.07.2025

Abstract

Purpose: This study examines the test equating performance under various item response theory models and sample size conditions in testlet based tests.

Design/Methodology/Approach: Utilizing data from the eTIMSS 2019 science test, the study compares scale transformation methods and test equating results under Unidimensional Item Response Theory (UIRT), Testlet Response Theory (TRT) and bifactor models with varying sample sizes. Scale transformation methods, including the mean-sigma and Stocking-Lord methods, as well as observed and true score equating methods, were employed within the framework of a common-item nonequivalent groups design. To evaluate the equating performance, RMSE and BIAS values were calculated.

Findings: The findings indicate that in a science test with low testlet effects, scale transformation results based on the UIRT model and test equating results based on the bifactor model demonstrated lower error rates. Moreover, as sample size increased, the error in parameter estimations generally decreased, with the TRT model specifically requiring a sample size of at least 500 for robust estimations.

Highlights: The bifactor model, taking testlet effects into account, yielded more precise and consistent results, facilitating fair and reliable score equating. This study, utilizing real data, concretely illustrates the practical implications of testlet effects in tests containing testlets.

Öz

Çalışmanın amacı: Bu çalışmada madde takımları içeren testlerde farklı madde tepki kuramı modelleri ve örneklem büyüklükleri koşullarına dayalı test eşitleme performansları incelenmiştir.

Materyal ve Yöntem: Bu amaçla araştırmada, eTIMSS 2019 bilim testine ait veriler kullanılarak, Tek Boyutlu Madde Tepki Kuramı (TBMTK), Madde Takımı Tepki Kuramı (MTTK) ve bifaktör modelleri altında farklı örneklem büyüklüklerinde yapılan ölçek dönüştürme yöntemleri ve test eşitleme sonuçları incelenmiştir. Denk olmayan gruplarda ortak madde deseni altında ortalama-sigma ve Stocking-Lord ölçek dönüştürme yöntemleri ve gerçek ile gözlenen puana dayalı eşitleme yöntemleri kullanılmıştır. Değerlendirme ölçütleri olarak RMSE ve BIAS değerleri hesaplanmıştır.

Bulgular: Genel olarak düşük düzeyde madde takımı etkisinin olduğu bilim testinde TBMTK modeline dayalı ölçek dönüştürme ve bifaktör modele dayalı test eşitleme sonuçlarının daha düşük hata değerleri ürettiği görülmüştür. Ayrıca örneklem büyüklüğü arttıkça genel olarak parametre kestirimlerinin hata değerlerinin azaldığı gözlemlenmiş olup özellikle MTTK ile çalışıldığında örneklem sayısının 500'den fazla olması gerektiği sonucuna varılmıştır.

Önemli Vurgular: Madde takımı etkisi göz önüne alındığında, bifaktör model daha doğru ve kararlı sonuçlar sunarak adil ve güvenilir puan eşitlemesi yapılmasını sağlamaktadır. Gerçek veri seti kullanılarak gerçekleştirilen bu çalışma ile madde takımları içeren testlerde madde takımı etkisinin pratikte nasıl bir etki yarattığı somut bir şekilde ortaya konulmuştur.

¹ A part of this study was presented at the 9th International Conference on Measurement and Evaluation in Education and Psychology in 2024.

² Corresponded Author, Ministry of National Education, İstanbul, Türkiye; <https://orcid.org/0000-0001-5671-6858>

³ Hacettepe University, Department of Educational Sciences, Ankara, Türkiye; <https://orcid.org/0000-0002-3580-5568>

⁴ Kütahya Dumlupınar University, Department of Educational Sciences, Kütahya, Türkiye; <https://orcid.org/0000-0002-6453-3258>

INTRODUCTION

Assessment in education is a pivotal tool for decision-making in areas such as academic achievement, selection, placement, promotion and access to educational opportunities. In particular, the validity and reliability of large-scale test scores, both at the national and international levels, are of critical importance. For instance, ensuring the security and comparability of items in selection exams administered at different times but serving the same purpose represents a significant challenge. Consequently, multiple parallel test forms are often developed for the same purpose. However, the interchangeability of these forms necessitates empirical evidence demonstrating their equivalence. Test equating encompasses statistical procedures designed to ensure that scores obtained from comparable tests, which are administered for the same purpose and share similar difficulty and content, can be used interchangeably (Kolen & Brennan, 2014). Through test equating, the comparability and validity of scores across different test forms are maintained, thereby supporting fair decision-making processes. However, the equating process can encounter specific challenges in practice. One notable complication arises from the use of testlets, which are commonly employed in large-scale assessments. A testlet refers to a cluster of items that are linked to a shared stimulus, such as a text, graphic, figure or table (Wainer & Kiely, 1987). Testlets offer the advantage of reducing the cognitive load for examinees by enabling multiple items to be developed based on a single stimulus, thereby allowing for the inclusion of more items within a given testing period (Bradlow et al., 1999). Nevertheless, this dependence on a common stimulus may violate the assumption of local independence (Lee et al., 2001; Wainer et al., 2007).

The primary issue in equating tests containing testlets stems from the violation of local independence, a foundational assumption in Item Response Theory (IRT). Local independence posits that, when individuals' ability (θ) levels are held constant, their responses to items should be statistically independent of one another (Lord, 1980). In the context of testlets, however, responses to items within the same testlet can influence one another, leading to local dependence. Such dependence can adversely affect the reliability of test scores, as well as the estimation of ability and item parameters (Marais & Andrich, 2008; Wainer & Wang, 2000; Yılmaz Koğar & Kelecioğlu, 2017). Consequently, this issue can undermine the accuracy of statistical analyses, including scale transformation methods and test equating processes, which are inherently reliant on parameter estimation. Thus, it is imperative to examine the testlet effect in assessments containing testlets and to consider its magnitude when determining the most appropriate measurement models. By addressing these challenges, the fairness and validity of score equating can be preserved.

To address the issue of local dependence in testlets, the literature proposes several IRT models beyond traditional approaches that treat testlet items as standalone items. One such approach involves scoring all items within a testlet polytomously to form a single unit, referred to as a "super item," using generalized partial credit model or graded response model (Wainer et al., 2007). However, a significant limitation of this method is the loss of information due to combining multiple items into a single polytomous item. To resolve this issue and explicitly model the dependencies among items within a testlet, the Testlet Response Theory (TRT) model was introduced. TRT was first developed by Bradlow et al. (1999) as an extension of the unidimensional IRT (UIRT) model specifically the two-parameter logistic (2PL) IRT model by incorporating an additional parameter to account for the testlet effect. This enhancement laid the foundation for TRT, allowing for the estimation of a testlet effect parameter (γ) for each testlet, which quantifies the influence of the testlet effect on individual performance (DeMars, 2006). The equation representing the 2PL-TRT model, incorporating the testlet effect parameter into the standard 2PL model, is provided in Equation (1).

$$P(\theta_i, \alpha_i, b_i) = \frac{\exp(\alpha_i(\theta_i - b_i - \gamma_{jd(i)}))}{1 + \exp(\alpha_i(\theta_i - b_i - \gamma_{jd(i)}))} \quad (1)$$

When conducting test equating under the TRT framework, multiple ability (θ) and discrimination (α) parameters are estimated based on the general trait measured by the test as well as the specific characteristics of the testlets. Specifically, the number of θ and α parameters estimated corresponds to the number of testlets in addition to the general factor. For instance, in a test comprising three testlets, four distinct θ and α parameters are estimated. However, the test equating process should rely on the general factor parameters, θ_1 and α_1 . This is because θ_1 and α_1 parameters are calculated by accounting for the testlet effect, whereas the other parameters are specific to each testlet and only influence responses to items within their respective testlet. This ensures that behaviors specific to each testlet do not generalize across the entire test (Tao & Cao, 2016).

The TRT model can be conceptualized as a constrained form of the bifactor model, which is a multidimensional IRT model positing that each item is associated with both a general (primary) factor and at most one specific (secondary) factor. In the bifactor model originally introduced by Gibbons and Hedeker (1992), there is one general factor and k specific factors. Each item in the test loads onto its corresponding specific factor, while also simultaneously loading onto the general factor (Gibbons & Hedeker, 1992). The model imposes no constraints; items are not influenced by factors other than the general or their designated specific factor. This allows for the independent examination of the effects of the general and specific factors (Rijmen, 2009). For dichotomous items, the bifactor model can be represented as follows (Cai et al., 2011):

$$P(\theta_0, \theta_s) = c_i + (1 - c_i) \frac{\exp(\alpha_{0i}\theta_0 + \alpha_{si}\theta_s + d_i)}{1 + \exp(\alpha_{0i}\theta_0 + \alpha_{si}\theta_s + d_i)} \quad (2)$$

In this formula, θ_0 represents the general factor, while θ_s represents the specific factor. The parameter c_i denotes the probability of guessing the correct answer, and d_i refers to the intercept parameter of the item. a_{0i} indicates the discrimination parameter associated with the general factor, whereas a_{si} indicates the discrimination parameter associated with the specific factor. Both the bifactor and TRT models address testlet effects in assessments involving testlets, but the selection of the appropriate model depends on the research question, data characteristics, and, most importantly, the magnitude of the testlet effect. In the literature, testlet effects are typically categorized into three levels: low (0.0–0.5), moderate (0.5–1.0) and large (above 1.0) (Cao et al., 2014; Wang et al., 2002).

TRT provides superior performance in tests where violations of local independence are prevalent. For tests with low testlet effects, such violations do not result in significant problems and UIRT may outperform multidimensional IRT models (Chen, 2014; He et al., 2012; Huang et al., 2022; Kim et al., 2019). However, in tests with large testlet effects, bifactor and TRT models are more accurate and are therefore recommended for test equating (Cao et al., 2014; He et al., 2012; Tao & Cao, 2016). However, a critical consideration when applying multidimensional IRT models is their dependence on large sample sizes (Reckase, 2009). Sample size significantly affects the accuracy of parameter estimation during the scaling process, which is a key step in test equating (Hambleton & Cook, 1983; Linacre, 1994; Wang & Liu, 2018). Larger sample sizes enhance the precision of test equating (Cui & Kolen, 2009; Liu & Kolen, 2011; Livingston, 1993; Skaggs, 2005). Consequently, there is a clear need for further research to investigate the role of sample size in studies focusing on multidimensional IRT models for assessments involving testlets.

Since different IRT models address local dependence in distinct ways, this variation may result in different outcomes, even when the same test equating process is employed. Consequently, the primary aim of this study is to examine the equating of scores obtained from tests comprising testlets using different IRT models and sample sizes and to provide a comparative analysis of the results. Therefore, before delving into the analysis phase, an overview of the stages, designs, and methods of test equating is presented.

Stages, Designs, and Methods in Test Equating

When two test forms developed for the same purpose are administered, variations in their means and standard deviations often emerge, rendering direct comparisons between the scores obtained from these forms impossible. To enable comparability, the scores must first be placed on a common scale. Subsequently, equating is applied to allow the scores to be used interchangeably. Test equating refers to the statistical transformation of test scores to account for differences in difficulty between test forms, enabling the scores to be used interchangeably (Kolen & Brennan, 2014). This process, which is critical for student evaluations, requires careful attention at each stage to ensure validity and reliability. The test equating process consists of four main stages: selection of the equating design, administration of the test forms, selection of the equating method, and evaluation of the equating results (Hambleton et al., 1991).

Test equating studies are conducted using various designs, the selection of which depends on the characteristics of the tests to be equated and the testing conditions. Common designs for test equating include the single group design, random groups design, single group design with counterbalancing, and common-item design for non-equivalent groups (CINEG), design (Kolen & Brennan, 2014). Based on the selected design, different test forms are administered to specific groups, followed by the application of a suitable equating method. The choice of equating method is determined by the characteristics of the test forms being equated. Test equating methods are generally developed within two theoretical frameworks: Classical Test Theory (CTT) and Item Response Theory (IRT). CTT-based methods include fundamental approaches such as mean equating, linear equating, and equipercentile equating (Hambleton et al., 1991).

IRT-based equating methods, on the other hand, rely on calibration approaches, which can be categorized into two types: concurrent calibration, where item parameters for all test forms are estimated simultaneously and automatically aligned to the same scale, and separate calibration, where item parameters for each test form are estimated independently (Kolen & Brennan, 2014). Due to practical constraints, separate calibration is often regarded as a safer alternative. In this method, scale transformation is necessary to ensure comparability of the estimated parameters. Scale transformation methods used in IRT-based separate calibration are classified into two categories: moment methods and characteristic curve methods. Moment methods include the mean-mean (MM) and mean-sigma (MS) approaches, while characteristic curve methods include the Stocking-Lord (SL) and Haebara (HB) methods. Detailed explanations of the MS and SL methods used in this study are provided below.

Mean-Sigma Method (MS): In this method, scale transformation coefficients are determined by using the mean and standard deviation of the difficulty parameters for the common items (Marco, 1977). The formulas for these coefficients are provided in Equations (3) and (4).

$$A = \frac{\sigma(b_i)}{\sigma(b_j)} \quad (3)$$

$$B = \mu(b_j) - A \cdot \mu(b_i) \quad (4)$$

$\mu(b_i)$: The mean of the difficulty parameters of the common items in Test i .

$\mu(b_j)$: The mean of the difficulty parameters of the common items in Test j .

$\sigma(b_i)$: The standard deviation of the difficulty parameters of the common items in Test i .

$\sigma(b_j)$: The standard deviation of the difficulty parameters of the common items in Test j .

Stocking-Lord Method (SL): This method aims to reduce the differences between the item characteristic curves for the common items. In this method, the total differences between the item characteristic functions, considering both the item difficulty and discrimination parameters, are computed (Stocking & Lord, 1983). The formula is given in Equation (5).

$$SL_{diff}(\theta_i) = \left(\sum_{j:V} \left[p_{ij}(\theta_{jj}; \hat{a}_{jj}, \hat{b}_{jj}, \hat{c}_{jj}) - \sum_{j:V} p_{ij} \left(\theta_{jj}; \frac{\hat{a}_{ij}}{A}; A\hat{b}_{ij} + B\hat{c}_{ij} \right) \right] \right)^2 \quad (5)$$

p_{ij} : Item characteristic function for the respondent i and the item j

$\hat{a}_{jj}, \hat{b}_{jj}, \hat{c}_{jj}$: Item discrimination, difficulty, and guess parameters for the common item j in Scale J

$\hat{a}_{ij}, \hat{b}_{ij}, \hat{c}_{ij}$: Item discrimination, difficulty, and guess parameters for the common item j in Scale I

$j: V$: The total is taken over the common items.

The scale transformation methods described are approaches developed to represent the parameters obtained from different test forms on the same scale. When these methods are applied based on UIRT, they may encounter issues related to the local independence assumption in tests containing testlets. To evaluate the performance of individuals who take different test forms, test equating is conducted. The primary distinction between test equating and scale transformation lies in their objectives: test equating provides evidence that the scores obtained from different test forms can be used interchangeably, while scale transformation establishes a relationship between the parameters of the test forms. In other words, while scale transformation connects the parameters of the tests, test equating ensures that individuals' scores can be used interchangeably. Therefore, the methods used in test equating and scale transformation also differ significantly (Ryan & Broockmann, 2009). In this study, two primary approaches to IRT-based equating—true score equating and observed score equating—were employed during the equating processes. True score equating focuses on the potential performance individuals exhibit on different test forms, whereas observed score equating uses the actual test scores obtained by individuals (Kolen & Brennan, 2014). Both methods aim to make comparisons between different test forms possible, but they are grounded in distinct theoretical frameworks and practical approaches. Understanding the differences and applications of these two methods is critical for conducting test equating more accurately and reliably.

True score equating and observed score equating are two fundamental methods used to ensure comparability of scores across different test forms. True score equating allows for the comparison of true scores on different tests independently of individuals' abilities and requires the calculation of all item parameters (Ogasawara, 2003; Kolen & Brennan, 2014). Observed score equating, on the other hand, operates on the distributions of observed correct responses, comparing the number of items answered correctly on each test form (Tao & Cao, 2016; Kolen & Brennan, 2014). Both methods utilize scale transformation techniques such as characteristic curve methods (Stocking-Lord and Haebara) and moment methods (Mean-Mean and Mean-Sigma) (Kolen & Brennan, 2014). As observed in some previous studies, a selective approach was adopted, whereby not all methods were utilized (He et al., 2015; Öztürk Gübeş, 2019; Robitzsch, 2024; Yıldırım Seheryeli et al., 2021). In this study, the Stocking-Lord method was preferred for its ability to minimize parametric differences and provide greater flexibility (Asriadi & Retnawati, 2023; Kilmen & Demirtaşlı, 2012; Özdemir & Atar, 2022; Robitzsch, 2024; Stocking & Lord, 1983; Uysal & Kilmen, 2016), while the Mean-Sigma method was selected because it takes variances into account, yielding more precise equating results (Kolen & Brennan, 2014; Öztürk Gübeş & Kelecioğlu, 2015).

Purpose of the Study

The necessity of the equating process lies in ensuring that the scores obtained by candidates from exams accurately reflect their true achievement levels. For instance, if a student scores low on a difficult test but high on an easier one, this may lead to misleading decisions about the student. Therefore, test equating processes form the foundation of fair and valid assessments in education. It is crucial that this process is conducted meticulously, particularly in cases where local dependency might arise, such as with testlets.

Researchers have conducted numerous studies addressing local item dependencies in tests composed of testlets and proposed various approaches. However, more studies are needed to investigate the impact of such dependencies on the performance of scale transformation and test equating (Cao et al., 2014; Chen, 2014; He, 2012; Huang et al., 2022; Kim et al., 2019; Tao & Cao, 2016). Evidence on the application of IRT models for scale transformation in tests containing testlets is scarce, warranting further research into their performance. For this reason, different IRT models are considered as a condition in this study. Furthermore, the literature reveals that scale transformation results for common-item designs in non-equivalent groups have not been adequately examined using real data. Since most studies rely on simulation data, the common items typically consist only of testlets. However, in real test applications, common items may include both testlets and standalone items, with some testlet effects being low, others moderate, and some high. Hence, this study, based on a real dataset containing both standalone items and testlets, is anticipated to provide a unique contribution to the literature.

Sample size is also a critical factor influencing the accuracy of parameter estimation and the test equating process (Tao & Cao, 2016). IRT models that account for testlet effects require larger sample sizes due to their inclusion of more parameters (Reckase,

2009). Additionally, Huang et al. (2022) concluded in their study that simpler models such as UIRT demonstrate acceptable error and bias levels with larger sample sizes. Consequently, this study incorporates different sample sizes as a condition when comparing the performance of scale transformation methods for common-item designs in non-equivalent groups using real data from tests containing testlets. In conclusion, the study seeks to answer the following research questions:

1. How do the RMSE and BIAS values of item parameters obtained from different scale transformation methods (MS-SL) change when different IRT models (UIRT-TRT-bifactor) are used under varying sample sizes (500-1000-2000-4279) in the eTIMSS science test (booklets 3 and 4)?

2. How do the RMSE and BIAS values of test equating methods (true score and observed score equating) based on different scale transformation methods (MS-SL) vary in the eTIMSS science test (booklets 3 and 4)?

METHOD

Research Design

This study aims to investigate scale transformation and test equating methods based on different IRT models and sample sizes in tests containing testlets, seeking to obtain detailed insights. In this respect, the study is descriptive in nature (Büyüköztürk et al., 2020).

Study Group

The data for the study were drawn from the student responses to the relevant booklets of the eTIMSS 2019 application across all participating countries. Since sample size is also considered as a condition, random subsamples of 500, 1,000, and 2,000 students were selected from the original dataset of 4,279 students. In line with previous studies suggesting that at least 500 examinees are needed for successful test equating (Spence, 1996) and that larger samples yield more accurate results, analyses were conducted using these sample sizes along with the full sample of 4,279 students (Atalay Kabasakal, 2014; Doğuyurt, 2023; Huang, 2022; Uğşul, 2024). The reason for the selection of these booklets is that when all the booklets with common items were reviewed, these booklets contained the highest number of testlets within the common items.

Data and Equating Design

The study employed a common-item design for non-equivalent groups (CINEG), which is frequently used in scale transformation methods and fits the structure of the data. The equating design is presented in Table 1. The data in this study consist of dichotomous variables scored as 0 or 1.

Table 1. Equating Design

Sample	Booklet 3	Common Items	Booklet 4
group 1	+	+	
group 2		+	+

In the CINEG design presented in Table 1, Booklet 4 is equated to Booklet 3 based on the common items. In this study, Booklet 4 of the science test was equated to Booklet 3. The standalone items, testlets, and total number of items included in the booklets of the science test are shown in Table 2.

Table 2. Number of Items in the Science Test

	Booklet 3	Booklet 4	Common Items
Number of standalone items	25	26	14
Number of two-item testlets	1	2	1
Number of three-item testlets	1	-	-
Number of four-item testlets	1	1	1
Number of seven-item testlets	1	1	1
Total number of items	41	41	27

As shown in Table 2, a total of 27 items are common between the booklets. Of these common items, 14 are standalone items, while the remainder are testlets. Among the testlets, one consists of two items, one consists of four items, and one consists of seven items. The testlet effects for the testlets in the science test are presented in Table 3.

Table 3. Testlet Effects in the Science Test

Testlet	Booklet 3	Booklet 4
T1 (2 items)	0.170	
T2 (2 items)*	0.315	0.220
T3 (2 items)		0.254
T4 (4 items)*	0.535	0.589
T5 (7 items)*	0.397	0.335

T=Testlet ; * =Common Testlet

When the testlet effects of the science test are examined in Table 3, it is observed that in Booklet 3, T1, T2, and T3 have low levels of testlet effects, while T4 demonstrates a moderate level. In Booklet 4, T2, T3, and T5 exhibit low levels of testlet effects, whereas T4 has a moderate testlet effect.

Data Analysis

In the analysis phase, the testlet effects in the science test booklets were first calculated, followed by the calibration of item responses using separate calibration, which yielded parameter estimates. The 2PL models provided a better fit to the data, and since the item parameter estimates in the 3PL model were substantially high, the 2PL model was preferred. Ability (Theta) parameters were estimated using the Expected A Posteriori method, while item parameters were estimated using the Maximum Likelihood Estimation (MLE) method (Embretson & Reise, 2000). The accuracy of the equating results was evaluated using the BIAS value, representing the difference between estimated and true parameter values, and the RMSE value, representing the total equating error. The closer these values are to zero, the more precise the equating results (Kolen & Brennan, 2014). The RMSE formula is provided in Equation (8), while the BIAS formula is provided in Equation (9). In the formula, N represents the total number of individuals, $\hat{x}_i$ denotes the estimated parameter for item i , x_i refers to the true parameter for item i .

$$RMSE = \sqrt{\frac{\sum_{i=1}^K (\hat{x}_i - x_i)^2}{N}} \quad (6)$$

$$BIAS = \frac{\sum_{i=1}^K (\hat{x}_i - x_i)}{N} \quad (7)$$

Although RMSE and BIAS values are useful for assessing the overall performance of the equating process, they do not provide information about whether the errors are within acceptable limits. At this stage, the Differences That Matter (DTM) framework (Dorans & Feigenbaum, 1994) offers a more tangible and practical criterion for evaluating the magnitude of errors in practical terms (Kolen & Brennan, 2014; Lee et al., 2012). According to this criterion, if error values are smaller than 0.5, the equating process is considered acceptable. This criterion was used to interpret the error values obtained in this study. Data analysis was conducted using the *mirt* package (Chalmers, 2012) and the *plink* package (Weeks, 2010) in R programming.

FINDINGS

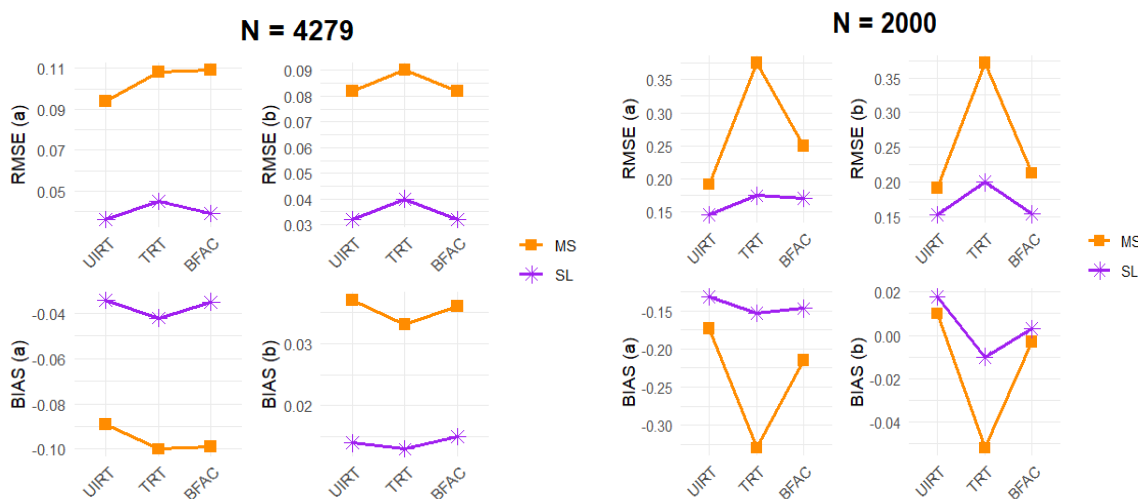
This section presents findings regarding how error and bias values of IRT-based scale transformation methods (MS, SL) vary under different IRT models and sample sizes in the eTIMSS science dataset, which comprises testlets and standalone items from Booklets 3 and 4. Under these conditions, the RMSE and BIAS values related to item parameters are provided in Table 4.

Table 4. Error Values Across All Conditions for Scale Transformation Methods

Scale Transformation Methods	Sample Size	Model	RMSE		BIAS	
			a	b	a	b
Mean-Sigma	4279	UIRT	0.094	0.082	-0.089	0.037
		TRT	0.108	0.09	-0.1	0.033
		Bifactor	0.109	0.082	-0.099	0.036
	2000	UIRT	0.191	0.192	-0.173	0.01
		TRT	0.375	0.371	-0.33	-0.052
		Bifactor	0.25	0.213	-0.215	-0.003

Stocking-Lord	1000	UIRT	0.215	0.251	0.189	0.016
		TRT	0.249	0.283	0.212	0.033
		Bifactor	0.258	0.273	0.217	0.027
	500	UIRT	0.302	0.265	-0.24	-0.126
		TRT	0.589	0.252	-0.302	-0.123
		Bifactor	0.497	0.304	-0.351	-0.139
	4279	UIRT	0.036	0.032	-0.034	0.014
		TRT	0.045	0.04	-0.042	0.013
		Bifactor	0.039	0.032	-0.035	0.015
	2000	UIRT	0.145	0.153	-0.131	0.018
		TRT	0.174	0.2	-0.153	-0.01
		Bifactor	0.17	0.154	-0.147	0.003
	1000	UIRT	0.275	0.338	0.242	0.019
		TRT	0.327	0.394	0.278	0.035
		Bifactor	0.332	0.373	0.28	0.039
	500	UIRT	0.189	0.227	-0.15	-0.163
		TRT	0.4	0.238	-0.205	-0.177
		Bifactor	0.288	0.248	-0.204	-0.179

When the error values of item parameter estimate for each scale transformation method presented in Table 4 are examined under the conditions of IRT models and sample sizes, it is observed that the UIRT, bifactor, and TRT models consistently yield the lowest error values, respectively. Moreover, a general trend indicates that as the sample size decreases, the error values of parameter estimates increase. While the evaluation criteria employed during the equating process (e.g., BIAS, RMSE) are particularly practical for comparative analyses, they remain insufficient in determining the acceptability of the results. Accordingly, when assessed using the DTM criterion, it is evident that, among the MS methods, all values—except for the RMSE value of the TRT discrimination parameter with a sample size of 500—fall below 0.5, signifying their acceptability. To facilitate interpretation and enable a more detailed analysis, a line graph illustrating the parameter error values estimated under varying sample size and IRT model conditions is presented in Figure 1.



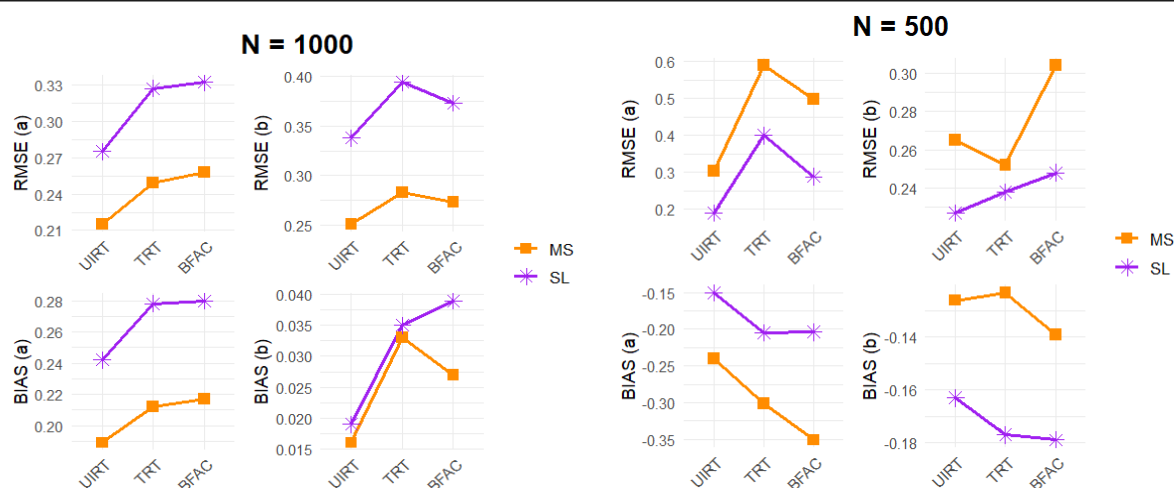


Figure 1. Line Graph of Error Values Under All Conditions According to Scale Transformation Methods

A review of Figure 1 reveals that parameter estimation error values are predominantly the highest for the MS method (except for $N=1000$). In contrast, the results derived from the SL methods are observed to be significantly similar across most conditions and consistently lower than those obtained from the MS method. Notably, all computed values remain below the threshold of 0.5, signifying their acceptability. Moreover, a model-specific analysis indicates that the UIRT model yields the lowest error values for both the a and b parameters. In cases involving larger sample sizes, the bifactor model exhibits error values comparable to those of the UIRT model. Additionally, the BIAS values across all conditions are found to be exceptionally low.

For the real dataset featuring the optimal sample size ($n=4279$), descriptive statistics of the common item parameters, as well as the equating constants corresponding to the scale transformation methods, have been computed for both test forms and are summarized in Table 5.

Tablo 5. Descriptive Statistics of Common Item Parameters and Equating Constants by Forms

	IRT				TRT				Bifactor			
	Form X		Form Y		Form X		Form Y		Form X		Form Y	
	a	b	a	b	a	b	a	b	a	b	a	b
Mean	1.123	-0.629	1.098	-0.605	1.162	-0.664	1.135	-0.647	1.229	-0.741	1.251	-0.79
Sd	0.351	0.989	0.357	1.072	0.393	1.038	0.415	1.134	0.485	1.165	0.550	1.57
	MS		SL		MS		SL		MS		SL	
	a	b	a	b	a	b	a	b	a	b	a	b
A	0.922	0.969	0.915	0.962	0.742	0.937						
B	-0.070	-0.027	-0.071	-0.032	-0.154	-0.068						

When Table 5 is examined, it is observed that the mean values of the a and b parameters for the common items are consistent across all models, with the equating constants being nearly identical in both the IRT and TRT models.

Descriptive statistics for the parameter values of the common items were calculated for each model using two scale transformation methods MS (moment methods) and SL (characteristic curve methods) in the scaled form.

Table 6. Descriptive Statistics of Item Parameters in Scaled Form

	UIRT				TRT				Bifactor			
	MS		SL		MS		SL		MS		SL	
	a	b	a	b	a	b	a	b	a	b	a	b
Mean	1.100	-0.490	1.047	-0.467	1.135	-0.647	1.177	-0.653	1.251	-0.79	1.229	-0.741
Sd	0.402	0.783	0.383	0.823	0.415	1.134	0.431	1.091	0.550	1.57	0.485	1.165

In Table 6, it is also apparent that the mean values of the common item parameters are quite similar in both the UIRT and TRT models.

A test equating procedure was performed based on both observed and true scores using the SL (characteristic curve methods) and MS (moment methods) scale transformation methods on the real dataset. Weighting was applied during observed score equating. Specifically, ten ability (theta) points were selected within the range of $[-4, 4]$, as recommended by Kolen and Brennan (2014). Subsequently, rescaled theta points were obtained based on the A and B constants derived from the scale transformation methods. Additionally, the standard normal distribution density was computed.

The observed score equating was performed using the rescaled theta points and weights, with the results presented in Table 7.

Table 7. RMSE and BIAS Values Based on Observed and True Score Equating

Equating Method	Model	Mean-Sigma		Stocking Lord	
		RMSE	BIAS	RMSE	BIAS
Observed Score-Based	UIRT	0.795	-0.326	0.467	-0.199
	TRT	0.812	-0.313	0.495	-0.277
	Bifactor	0.769	-0.299	0.413	-0.227
True Score-Based	UIRT	0.808	-0.260	0.471	-0.153
	TRT	0.824	-0.249	0.493	-0.161
	Bifactor	0.786	-0.237	0.439	-0.152

Upon reviewing Table 7, it is evident that the best results were obtained for the bifactor model in both observed and true score equating methods. The RMSE values for all models, derived from the MS method, were greater than 0.5 in both equating methods, thus failing to meet the DTM criterion. On the other hand, the BIAS values remained below 0.5 across all scale transformation and equating methods.

Figure 2 presents line graphs depicting the variation of error values for observed and true scores based on the MS and SL scale transformation methods. In the UIRT model, the RMSE values resulting from both observed and true score equating were nearly identical for both the MS and SL scale transformation methods. In the TRT model, although the RMSE values were similar, the bifactor model displayed differences, with the MS method producing higher RMSE values. When examining the RMSE and BIAS values, it can be concluded that the SL scale transformation method produced lower error values across all models.

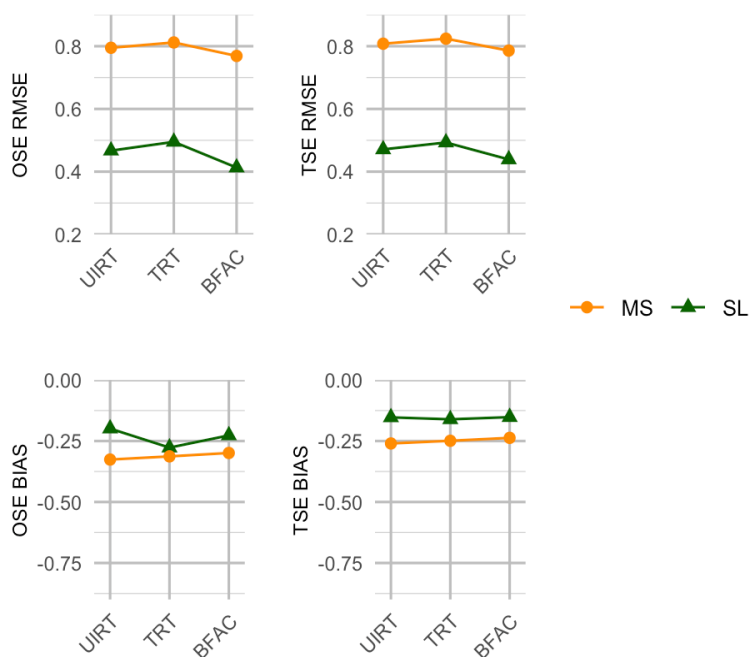


Figure 2. Line Graph of Error Values Based on OSE and TSE Equating

Table 8 presents the averages and standard deviations of the original forms and the scores equated from Form 4 to Form 3, based on the observed and true scores for all three models.

Table 8. Moments for equating Form X and Y

	Form	UIRT		TRT		Bifactor	
		Mean	Sd	Mean	Sd	Mean	Sd
True Score	Equating	20.653	12.579	20.661	12.586	20.652	12.575
Observed Score	Equating	20.699	12.595	20.778	12.602	20.727	12.566
Original Score	Booklet 3	23.925	7.576				
	Booklet 4	24.190	7.701				

As seen in Table 8, using the IRT true score equating, the average score for Form 4 equated to the 3rd Form is 20.653; when using the IRT observed score equating, the average is 20.699. For TRT, these scores are 20.661 and 20.778, respectively. The values obtained for the bifactor model are quite similar to those for the UIRT model, with values of 20.652 and 20.727, respectively. The moments of the transformed scores are very similar for the two IRT methods. Furthermore, without using the IRT model, the averages for the original Forms 3 and 4 are 23.925 and 24.190, respectively.

RESULTS AND DISCUSSION

This study compares the error values (RMSE-BIAS) obtained from different scale transformation methods (MS-SL) and equating methods (OSE-TSE) under various conditions, including different sample sizes (500-1000-2000-4279) and IRT models (UIRT-TRT-bifactor), for equating the 3rd and 4th Forms of the eTIMSS 2019 science test based on a common test design across unequal groups. The results of the study show that when the testlet effect in the science test is at a medium or low level, the scale transformations based on UIRT yield lower RMSE and BIAS values for parameter errors. This finding is consistent with previous studies in the literature, which have shown that the UIRT model provides better results in datasets with a low testlet effect (Chen, 2014; He, 2012; Huang et al., 2022; Kim et al., 2019; Tao & Cao, 2016). When comparing the bifactor and TRT models, it was found that the error values obtained from the bifactor model were lower. In fact, in large samples, the error values obtained from bifactor and UIRT models were quite similar. This suggests that bifactor models better model the local independence violations caused by testlet effects and should be preferred for scale transformation studies in tests where the testlet effect is present.

When examining the research findings related to sample size, under the CİNEG design, errors in parameter estimation for scale transformation methods generally decreased as sample size increased in all models. This result aligns with the information in the literature, which indicates that equating procedures require a large sample size for accurate parameter estimation (Babcock & Hodge, 2019; Huang et al., 2022; Kolen & Brennan, 2014). Specifically, for datasets with a sample size of 500, the RMSE value can be high when using the TRT model. This is likely due to the TRT model treating each testlet as a separate dimension, which necessitates larger sample sizes in analyses (Wainer et al., 2007). Therefore, when using the 2PL-TRT model for tests composed entirely of testlets, the sample size should be greater than 500.

In all models and sample sizes, the highest parameter estimation error values were generally observed with the MS method. The SL method, on the other hand, produced lower errors compared to the MS method. This finding is consistent with the results of Gök and Kelecioğlu (2014) and Ogasawara (2001) but contradicts the findings of Gül et al. (2017) and Kim & Lee (2006). In true score equating and observed score equating, among the two scale transformation methods used (MS-SL), the MS method again resulted in higher RMSE values across all models. The reason for this outcome in true and observed score equating may be attributed to the more erroneous parameter estimations made by the MS method compared to the SL method during the scale transformation process. Research comparing characteristic curve methods (SL) with moment methods (MS) for binary IRT models has demonstrated that characteristic curve methods yield more stable results (Baker & Al-Karni, 1991; Gül et al., 2017; Hanson & Béguin, 2002; Kim & Cohen, 1991; Kolen & Brennan, 2014; Lee & Ban, 2010; Li et al., 2012; Ogasawara, 2001; Zor, 2023).

True and observed score equating were conducted with a sample size of 4279 using the SL and MS scale transformation methods. Most of the error values in this case were found to be below the DTM criterion, with the results of equating using only the MS scale transformation method showing errors exceeding 0.5. Furthermore, the bifactor model provided the best results in both true and observed score equating. Therefore, the use of the bifactor model based on the SL scale transformation method in equating studies may be appropriate. The literature also suggests that when the testlet effect is low, the bifactor model is a suitable option for test equating (He et al., 2012; Kim et al., 2019). Additionally, the results obtained align with the findings of He & Li (2014), where the bifactor model produced the lowest error in equating studies. Thus, in tests predominantly or entirely composed of testlets, where the testlet effect needs to be considered, using the bifactor model with an adequate sample size would be more appropriate.

Upon examining the results of observed and true score equating, it was found that the equating based on observed scores generally produced lower error values. Only the equating results for the TRT model using the SL scale transformation method were found to be quite similar. However, studies in the literature have shown that true and observed score equating based on the UIRT model yield indistinguishable results (Cao et al., 2014; Han et al., 1997; Lord & Wingersky, 1984).

A significant contribution of this study is that, although most studies in the literature regarding testlets have been conducted using simulation data (Cao et al., 2014; Chen, 2014; Huang et al., 2022; Kim et al., 2019; Tao & Cao, 2016), this study was carried out with real data. Unlike simulation data, the use of real data offers a more tangible understanding of how the testlet effect and violations of local item independence affect the results in practice. These results underscore the importance of controlling for the testlet effect in testlet based tests and highlight the applicability of the UIRT model in cases where the testlet effect is low or when most of the items in the test are standalone items.

In the common-item nonequivalent groups (CINEG) design, the proportion of common items (i.e., the ratio of common items to the total number of items) is a critical factor in test equating. As a general guideline, the literature recommends that the proportion of common items should be at least 20%. This proportion is recognized as one of the key factors affecting the accuracy of equating, and it is particularly advised to maintain a higher proportion when the total number of items in the test is relatively small (Kolen & Brennan, 2014). In the present study, the proportion of common items exceeds the recommended range, which is considered advantageous for enhancing the accuracy of the equating process. However, this research has some important limitations. Since the study was conducted using a real dataset, the number of testlets in the eTIMSS science test for Forms 3 and 4 was considerably lower than the number of standalone items, and the testlet effect was low. Therefore, future studies should focus on tests composed entirely of testlets or with a similar number of standalone and testlet items. Additionally, working with real datasets exhibiting a strong testlet effect will provide clearer insights into the impact of local dependence on the models. Furthermore, research addressing conditions such as sample size, the number of testlet items, standalone items, testlet effects and the ability distribution (kurtosis-skewness) of the dataset, whether based on real or simulation data, would provide significant contributions to the literature.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, author-ship, and/or publication of this article.

Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

In this study, the eTIMSS 2019 dataset, which is directly downloadable from the TIMSS 2019 International Database website, was used. Since no data collection process was involved in obtaining open-access dataset, ethical committee approval was not required.

References

- Asriadi M., H. (2023). Equating of standardized science subjects tests using various methods: which is the most profitable? *Thabiea : Journal of Natural Science Teaching*, 6(1), 51-64.
- Atalay Kabasakal, K. (2014). *Değişen madde fonksiyonunun test eşitlemeye etkisi* [Doktora tezi]. Hacettepe Üniversitesi.
- Babcock, B., & Hodge, K. J. (2020). Rasch versus classical equating in the context of small sample sizes. *Educational and Psychological Measurement*, 80(3), 499-521. <https://doi.org/10.1177/0013164419878>
- Baker, F. B. & Al-Karni, A. (1991). A comparison of two procedures for computing IRT equating coefficients. *Journal of Educational Measurement*, 28(2), 147-162 <https://doi.org/10.1111/j.1745-3984.1991.tb00350.x>
- Bradlow, E. T., Wainer, H., & Wang, X. (1999). A Bayesian random effects model for testlets. *Psychometrika*, 64(2), 153-168. <https://doi.org/10.1007/BF02294533>
- Büyüköztürk, Ş., Kılıç Çakmak, E., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2020). *Eğitimde bilimsel araştırma yöntemleri*. Pegem Akademi.
- Cai, L., Yang, J. S., & Hansen, M. (2011). *Generalized full-information item bifactor analysis*. *Psychol Methods*, 16(3), 221-248. 10.1037/a0023350

- Cao, Y., Lu, R., & Tao, W. (2014). *Effect of item response theory (IRT) model selection on testlet-based test equating* (ETS Research Report No. RR-14-19). Educational Testing Service. <https://doi.org/10.1002/ets2.12017>
- Chalmers, R. P. (2012). mirt: A Multidimensional Item Response Theory Package for the R Environment. *Journal of Statistical Software*, 48(6), 1–29. <https://doi.org/10.18637/jss.v048.i06>
- Chen, J. (2014). *Model selection for IRT equating of testlet-based tests in the random groups design* [Doctoral dissertation] The University of Iowa. ProQuest Dissertations Publishing.
- Cui, Z., & Kolen, M. J. (2009). Evaluation of two new smoothing methods in equating: The cubic B-spline presmoothing method and the direct presmoothing method. *Journal of Educational Measurement*, 46(2), 135-158. <https://doi.org/10.1111/j.1745-3984.2009.00074.x>
- DeMars, C. (2006). Application of the bi-factor multidimensional item response theory model to testlet-based tests. *Journal of Educational Measurement*, 43(2), 145–168. <https://doi.org/10.1111/j.1745-3984.2006.00010.x>
- Doğuyurt, A. (2023). *İkili puanlanan testlerde yerel madde bağımsızlık varsayımının ihlâlinin test eşitleme yöntemlerine etkisi* [Doctoral dissertation]. Gazi Üniversitesi.
- Dorans, N. J., & Feigenbaum, M. D. (1994). *Equating issues engendered by changes to the SATR and PSAT/NMSQTR* (ETS RM-94-10). ETS.
- Embretson, S. E., & Reise, S. P. (2000). *Item response theory for psychologists*. Lawrence Erlbaum Associates.
- Gibbons, R. D., & Hedeker, D. (1992). Full information item bifactor analysis. *Psychometrika*, 57(3), 423-436. <https://doi.org/10.1007/BF02295430>
- Gök, B., & Kelecioğlu, H. (2014). Denk olmayan gruplarda ortak madde deseni kullanılarak madde tepki kuramına dayalı eşitleme yöntemlerinin karşılaştırılması. *Mersin Üniversitesi Eğitim Fakültesi Dergisi*, 10(1), 120-136. <https://doi.org/10.17860/efd.78698>
- Gül, E., Doğan-Gül, Ç., Çokluk-Bökeoğlu, Ö. & Özkan, M. (2017). Temel eğitimden ortaöğretime geçiş matematik alt testi asıl sınav ve mazeret sınavlarının madde tepki kuramına göre eşitlenmesi. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*, 17(4), 1900-1915. <https://doi.org/10.17240/aibuefd.2017.17.32772-363973>
- Haebara, T. (1980). Equating logistic ability scales by a weighted least squares method. *Japanese Psychological Research*, 22(3), 144–149.
- Hambleton, R.K., & Cook, L.L. (1983). Robustness of item response models and effects of test length and sample size on the precision of ability estimates. In D.J. Weiss (Ed.), *New horizons in testing: Latent trait test theory and computerized adaptive testing* (pp. 31-49). Vancouver.
- Hambleton, R. K., & Swaminathan, H. (1985). *Item response theory: Principles and applications*. Kluwer.
- Hambleton, R. K., Swaminathan, H., & Rogers, H. J. (1991). *Fundamentals of item response theory*. SAGE Publications.
- Han, T., Kolen, M., & Pohlmann, J. (1997). A comparison among IRT true-and-observed score equatings and traditional equipercentile equating. *Applied Measurement in Education*, 10, 105–121.
- Hanson, B. A. & Béguin, A. A. (2002). Obtaining a common scale for Item Response Theory item parameters using separate versus concurrent estimation in the common-item equating design. *Applied Psychological Measurement*, 26(1), 3-24. <https://doi.org/10.1177/0146621602026001001>
- He, W., Li, F., Wolfe, E. W., & Mao, X. (2012). Model selection for equating testlet-based tests in the NEAT design: An empirical study. *Annual NCME Conference*.
- He, Y., Zhongmin, C. & Osterlind, S. J. New robust scale transformation methods in the presence of outlying common items. *Applied Psychological Measurement* 39 (8), 613-626. <https://doi.org/10.1177/0146621615587003>
- Huang, F., Li, Z., Liu, Y., Su, J., Yin, L., & Zhang, M. (2022). An extension of testlet-based equating to the polytomous testlet response theory model. *Frontiers in Psychology*, 12, 743362. <https://doi.org/10.3389/fpsyg.2021.743362>
- Kilmen, S. & Demirtaşlı, N. (2012). Comparison of test equating methods based on item response theory according to the sample size and ability distribution. *Procedia - Social and Behavioral Sciences* 46, 130 – 134. [10.1016/j.sbspro.2012.05.081](https://doi.org/10.1016/j.sbspro.2012.05.081)
- Kim, S. & Cohen, A. S. (1991). Effects of linking methods on detection of DIF. *Journal of Educational Measurement*, 29(1), 51-66.
- Kim, S. & Lee, W. (2006). An extension of four IRT linking methods for mixed-format tests. *Journal of Educational Measurement*, 43(1), 53-76.
- Kim, K. Y., Lim, E., & Lee, W. C. (2019). A comparison of the relative performance of four IRT models on equating passage-based tests. *International Journal of Testing*, 19(3), 248–269. <https://doi.org/10.1080/15305058.2018.1530239>
- Kolen, M. J., & Brennan, R. L. (2014). *Test equating, scaling, and linking: Methods and practices* (3rd ed.). Springer.
- Lee, W. C., and Ban, J. C. (2009). Comparison of IRT linking procedures. *Applied Measurement in Education*, 23(1), 23-48. <https://doi.org/10.1080/08957340903423537>

- Lee, W., He, Y., Hagge, S., Wang, W., & Kolen, M. J. (2012). Equating mixed-format tests using dichotomous common items. In M. J. Kolen & W. Lee (Eds.), *Mixed-format tests: Psychometric properties with a primary focus on equating* (Vol. 2). CASMA Monograph. Iowa City, IA: Center for Advanced Studies in Measurement and Assessment, The University of Iowa.
- Lee, G., Kolen, M. J., Frisbie, D. A., & Ankenmann, R. D. (2001). Comparison of dichotomous and polytomous item response models in equating scores from tests composed of testlets. *Applied Psychological Measurement*, 25, 357–372. <https://doi.org/10.1177/01466210122032226>
- Linacre, J. M. (1994). Sample size and item calibration stability. *Rasch measurement transactions*, 7, 328.
- Liu, C., & Kolen, M. J. (2011). A comparison among IRT equating methods and traditional equating methods for mixed-format tests. *Mixed-format tests: Psychometric properties with a primary focus on equating*, 1, 75–94.
- Livingston, S. A. (1993). Small-sample equating with log-linear smoothing. *Journal of Educational Measurement*, 30(1), 23–29.
- Lord, F. M. (1980). *Applications of item response theory to practical testing problems*. Lawrence Erlbaum Associates.
- Lord, F. M. & Wingersky, M. S. (1984). Comparison of IRT true score and equipercentile observed score “equatings.”. *Applied Psychological Measurement*, 8, 453–46.
- Loyd, B. H., & Hoover, H. D. (1980). Vertical equating using the Rasch model. *Journal of Educational Measurement*, 17(3), 179–193.
- Marais, I. D., & Andrich, D. (2008). Effects of varying magnitude and patterns of local dependence in the unidimensional Rasch model. *Journal of Applied Measurement*, 9(2), 105–124.
- Marco, G. L. (1977). Item characteristic curve solutions to three intractable testing problems. *Journal of Educational Measurement*, 14(2), 139–160.
- Ogasawara, H. (2000). Asymptotic standard errors of IRT equating coefficients using moments. *Economic Review, Otaru University of Commerce*, 51(1), 1–23.
- Ogasawara, H. (2001). Least squares estimation of item response theory linking coefficients. *Applied Psychological Measurement*, 25, 3–24.
- Ogasawara, H. (2003). Asymptotic standard errors of IRT observed-score equating methods. *Psychometrika*, 68(2), 193–211.
- Özdemir, G., & Atar, B. (2022). Investigation of the missing data imputation methods on characteristic curve transformation methods used in test equating. *Journal of Measurement and Evaluation in Education and Psychology*, 13(2), 105–116. <https://doi.org/10.21031/epod.1029044>
- Öztürk Gübeş, N. & Kelecioğlu, H. (2016). The impact of test dimensionality, common-item set format, and scale linking methods on mixed format test equating. *Educational Sciences: Theory & Practice*, 16(3), 715–734. 10.12738/estp.2016.3.0218
- Öztürk Gübeş, N. (2019). Test eşitlemede çok boyutluluğun eş zamanlı ve ayrı kalibrasyona etkisi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, 34(4), doi: 1061-1074. 10.16986/HUJE.2019049186
- Reckase, M. D. (2009). *Multidimensional item response theory*. Springer.
- Rosenbaum, P. R. (1988). Items bundles. *Psychometrika*, 53(3), 349–359.
- Rijmen, F. (2009). Three multidimensional models for testlet-based tests: Formal relations and an empirical comparison. *ETS Research Report*, 2009(2), 1–41.
- Robitzsch, 2024. Bias-reduced Haebara and Stocking–Lord linking. *J Multidisciplinary Scientific journal*, 7(3), 373–384. <https://doi.org/10.3390/j7030021>
- Ryan, J., & Brockmann, F. (2009). *A Practitioner’s Introduction to Equating with Primers on Classical Test Theory and Item Response Theory*. Council of Chief State School Officers.
- Skaggs, G. (2005). Accuracy of random groups equating with very small samples. *Journal of Educational Measurement*, 42(4), 309–330. <https://doi.org/10.1111/j.1745-3984.2005.00018.x>
- Spence, P. (1996). *The effect of multidimensionality on unidimensional equating with item response theory* [Doctoral dissertation] University of Florida.
- Stocking, M. L., & Lord, F. M. (1983). Developing a common metric in item response theory. *Applied Psychological Measurement*, 7(2), 201–210.
- Tao, W., & Cao, Y. (2016). An extension of IRT-based equating to the dichotomous testlet response theory model. *Applied Measurement in Education*, 29(2), 108–121. <https://doi.org/10.1080/08957347.2016.1138956>
- Uşkul, B. (2024). *Madde takımı tabanlı testlerde ölçek dönüştürme hatalarının incelenmesi* [Doctoral dissertation]. Hacettepe Üniversitesi.
- Uysal, İ. & Kilmen, S. (2016). Comparison of item response theory test equating methods for mixed format tests. *International Online Journal of Educational Sciences*, 2016, 8 (2), 1–11. <http://dx.doi.org/10.15345/iojes.2016.02.001>
- Wainer, H., & Kiely, G. L. (1987). Item clusters and computerized adaptive testing: A case for testlets. *Journal of Educational Measurement*, 24(3), 185–202.

- Wainer, H., & Wang, X. (2000). Using a new statistical model for testlets to score TOEFL. *Journal of Educational Measurement*, 37(3), 203–220. <https://doi.org/10.1111/j.1745-3984.2000.tb01083.x>
- Wainer, H., Bradlow, E. T., & Wang, X. (2007). *Testlet response theory and its applications*. Cambridge University Press.
- Wang, X., Bradlow, E. T., & Wainer, H. (2002). A general Bayesian model for testlets: Theory and applications. *Applied Psychological Measurement*, 26(2), 190–218. <https://doi.org/10.1177/0146621602026001007>
- Wang, S. & Liu, H. (2018). Minimum sample size needed for equipercentile equating under the random groups design. In M. J. Kolen ve W. Lee (Ed.), *Mixed-format tests: Psychometric properties with a primary focus on equating* (vol 2.5, s. 107-126). Center for Advanced Studies in Measurement and Assessment.
- Weeks, J. P. (2010). plink: An R package for linking mixed-format tests using IRT-based methods. *Journal of Statistical Software*, 35(12), 1–33.
- Yıldırım Seheriyeli, M., Yahşi-Sarı, H., & Kelecioğlu, H. (2021). Comparison of Kernel Equating and Kernel Local Equating in Item Response Theory Observed Score Equating. *Journal of Measurement and Evaluation in Education and Psychology*, 12(4), 348-357. <https://doi.org/10.21031/epod.900843>
- Yılmaz Koğar, E., & Kelecioğlu, H. (2017). Examination of different item response theory models on tests composed of testlets. *Journal of Education and Learning*, 6(4), 113-126. 10.5539/jel.v6n4p113
- Zor, Y. M. (2023). Investigation of multidimensional scale transformation methods applied to multidimensional tests according to various conditions. *Adıyaman University Journal of Educational Sciences*, 13(1), 41-53. <http://dx.doi.org/10.17984/adyuebd.1239198>



| Research Article / Araştırma Makalesi |

Development of Attitude to Playing Baglama Scale

Bağlama Çalmaya İlişkin Tutum Ölçeğinin Geliştirilmesi¹

Mustafa DEMİR² Gökhan ÖZDEMİR³

Keywords

1. Baglama
2. Attitude
3. Attitude Scale
4. Validity Reliability

Anahtar Kelimeler

1. Bağlama
2. Tutum
3. Tutum Ölçeği
4. Geçerlik Güvenirlik

Received/Başvuru Tarihi

22.10.2024

Accepted / Kabul Tarihi

25.07.2025

Abstract

Purpose: In this research, the aim was to develop a measurement device in order to determine the attitudes of preservice music teachers about playing the baglama and to fill a gap in the literature due to the lack of a measurement device about playing the baglama.

Design/Methodology/Approach: Literature screening was performed and similar studies specific to education and music education were investigated. The pool of 50 Likert-type items was prepared and expert opinions sought. In line with expert opinions, the draft scale of 37 items was administered to 418 preservice music teachers receiving baglama education in the study group.

Findings: After suitable values were obtained with KMO (.960) and Bartlett's test ($p<0.05$), exploratory factor analysis was performed followed by confirmatory factor analysis. After exploratory and confirmatory factor analysis, the 'attitude to playing baglama scale' gained its final form comprising a total of 20 items in three sub dimensions of value (7), adjustment (8) and interest (5). The reliability value for this scale was $\alpha=0.961$, and it was identified to explain 70.572% of the total variance.

Highlights: As a result of the findings, it was concluded that the 'attitude to playing baglama scale' had high levels of validity and reliability.

Öz

Çalışmanın amacı: Bu araştırmada, müzik öğretmeni adaylarının bağlama çalmaya ilişkin tutumlarını belirleyebilmek için bir ölçme aracı geliştirmek ve alan yazında bağlama çalma konusu ile ilgili bir ölçme aracının bulunmaması bakımından alandaki boşluğu doldurmak amaçlanmıştır.

Materyal ve Yöntem: Literatür taraması yapılarak eğitim ve müzik eğitimi özelinde benzer çalışmalar incelenmiş, sonrasında Likert tipi 50 maddeden oluşan madde havuzu hazırlanmış ve uzman görüşü alınmıştır. Uzman görüşü doğrultusunda 37 maddeye düşürülen taslak ölçek, çalışma grubunda yer alan bağlama eğitimi almış 418 müzik öğretmeni adayına uygulanmıştır.

Bulgular: KMO (.960) ve Bartlett's testleri ($p<0,05$) sonrasında oluşan uygun değerler sonrasında açıklayıcı faktör analizi yapılmış ve alt boyutlar belirlenmiştir. Döndürülmüş faktör yük değerleri, madde analizi ve güvenilirlik testi uygulandıktan sonra doğrulayıcı faktör analizi yapılmıştır. Açıklayıcı ve doğrulayıcı faktör analizleri sonrasında Değer (7), Uyum (8) ve İlgi (5) alt boyutlarını içeren, toplamda 20 maddeden oluşan "Bağlama çalmaya ilişkin tutum ölçeği" son şeklini almıştır. Geliştirilen ölçeğin güvenilirlik değeri $\alpha=0,961$, toplamda açıkladığı varyansın ise %70,572 olduğu tespit edilmiştir.

Önemli Vurgular: Bulgular sonrasında geliştirilen "Bağlama Çalmaya İlişkin Tutum Ölçeği"nin yüksek düzeyde geçerli ve güvenilir olduğu sonucuna ulaşılmıştır.

¹ This study comprises part of the first author's doctoral thesis.

² **Corresponded Author**, Burdur Mehmet Akif Ersoy University Turkish Music State Conservatory, Burdur Mehmet Akif Ersoy University, Burdur, Türkiye; <https://orcid.org/0000-0001-8429-1113>

³ **Author**, Burdur Mehmet Akif Ersoy University Turkish Music State Conservatory, Burdur Mehmet Akif Ersoy University, Burdur, Türkiye; <https://orcid.org/0000-0001-5749-0205>

INTRODUCTION

Attitudes have always been one of the main elements in the social psychology discipline (McGuire, 1985, cited Prislin & Crano, 2008) and are almost a keystone in the structure of American social psychology (Allport, 1935, cited Oskamp & Schultz, 2005). Attitudes, in addition to making important aspects of human's lives understandable, affect functioning in groups, social structures and nations and are included in the center of studies in other academic disciplines including those of sociologists, political scientists, communication researchers and many other social scientists (Oskamp & Schultz, 2005). Further, in different periods of American history, areas like ideology and propaganda, consumer behavior and relationships between groups have attracted interest in different ways and places where work attitudes may be found were determined linked to areas of interest (Banaji & Heiphetz, 2010). Researchers studied how attitudes form, how they change, how they are represented in memory, and how they transform into cognition, motivation and action (Albarracin et al., 2005, p. 3).

Attitude is a psychological tendency expressed by evaluating the degree of favor or displeasure (Eagly and Chaiken, 1993, p. 1), of mental or nervous readiness, in relation to all objects and situations related to the individual (G. Allport, 1935, cited Malim, 1997, p. 149). It is a learned predisposition to continuously respond in positive or negative ways (Fishbein and Ajzen, 1975, cited Jaccard & Blanton 2005); 'a learned tendency toward positive or negative reactions' (Tezbaşaran, 2008, p. 1). When the many definitions of the attitude concept in the literature and the different attitude definitions mentioned above are investigated, it appears it involves three sub-dimensions of the cognitive, affective and behavioral fields (Burns & Dobson, 1983, p. 369). When the attitude concept is investigated in diachronic form, it appears that these dimensions initially were separate topics of studies, and later were combined as a single topic for study. For these reasons, Zanna and Rempel (1988) stated that these two approaches involve some problems, and proposed that two contradictory definitions were dominant which did not appear fully satisfactory after assessment of data from the two approaches. They explained this situation as a result of researchers producing many single-component views and the continuation of the problematic continuous relationship between attitude and behavior with the combination of the three components in a single definition (Zanna & Rempel, 1988). İnceoğlu (2011, p. 22) brought concepts about the areas of interest of the disciplines mentioned above to the forefront in this situation and made connections between assessments related to this concept.

As mentioned, the three-component approach including three elements gained broad acceptance; however, in more recent times, the behavioral component has begun to be questioned. Ajzen (1988), stating that it was difficult to see how knowing a person's attitude about something can help to realistically predict their behavior, proposed that people do not always act consistently with their attitudes. For example, people may be faced with conflict between contradictory attitudes (Malim & Birch, 1998, p. 649). Kağıtçıbaşı and Cemalcılar (2014) stated that in spite of this new orientation related to the concept of attitude, the three-component model is accepted. Additionally, inferring that the time factor was ignored in studies about whether attitudes have an effect on behavior or not, they emphasized that the basic condition for an attitude is mental assessment and that most settled attitudes included elements about feelings and behavior (Kağıtçıbaşı & Cemalcılar, 2014, p. 133-134). According to İnceoğlu (2011, p. 30), it is not possible to form attitudes when there is no 'internal consistency' between cognitive, affective and behavioral components and no organization.

As previously emphasized, it is assumed there is internal consistency between the three components related to this attitude concept. The basis of this assertion is that our knowledge and accumulation about a topic will create a positive or negative value, this will affect our behavior in relation to this topic in the future; for this reason, we will have an attitude about that topic. As can be seen, our knowledge, accumulation, experience and beliefs shape our value perceptions like good/bad and liking/not liking, and may be observed as verbal or active concrete outputs linked to the weakness or strength of these values. As stated by Tavşancıl (2014, p. 78), while strong attitudes may be observed in behavior due to these three components, weak attitudes may not be observed in behavior.

Cognition, feelings, intentions and organized behavior are very important content in the structure of attitudes. This explanation means that changes in any component may cause changes in another component. A change in belief may cause attitudes to be reviewed and for this reason a new attitude may cause a new behavior or an inverse process to be experienced. In conclusion, new attitudes may affect our thoughts about social objects; for this reason, changes in attitude may cause changes in belief (Zimbardo & Leippe, 1991, p. 34). For the topic of the interrelationship between attitude components, İnceoğlu (2011, p. 31) stated 'the emotional component cannot exist independent of the other two components.' Knowledge and experience acquired in the context of the cognitive component ensures development of the emotional element; as a result, they emphasize that as a result it tends to display/concretize as behavior. For this reason, to be able to measure an attitude, the presence of 'a range of observable behavior assumed to reflect it' is necessary (İnceoğlu, 2011, p. 39). Studies by Cüceloğlu (2006, p. 525) emphasized there was an important relationship between 'the cognitive aspect of attitude and the behavior aspect.' Assessing the results of these studies, Cüceloğlu connected the ability to transform this relationship into behavior as being connected to the strength of the attitude, based on the experiences of the individual, support by people affecting the individual and frequent chance of repetition. Additionally, research by Kağıtçıbaşı and Cemalcılar (2014, p. 138) about the topic stated that the information acquired about an attitude caused strengthening of the attitude.

In the context of the attitude-behavior relationship, two approaches emerge. The first, as emphasized by İnceoğlu (2011) like Cüceloğlu (2006, p. 521), is the approach emphasizing that attitudes can be observed as observable behavior. The other is that

view that attitudes are not observable behavior but an action preparing for behavior (Kağıtçıbaşı & Cemalcılar, 2014, p. 130). In a similar way, Ajzen and Fishbein (2005) stated that attitudes carry value from positive to negative, they show the position of the individual in relation to attitude content and are strong predictors of behavior related to attitudes. Jaccard and Blanton (2005) encountered the idea that very few studies about the concept of attitude can help us to understand and predict the behavior of individuals. For this reason, even today there is no clear assessment that can be made in relation to this topic, with researchers proposing the need to be able to observe the behavior component to measure attitudes. As a result, social psychologists proposed some theories and approaches in attempts to understand the norms in the relationship between attitude and behavior.

To date, most research about the role of norms in the attitude-behavior relationship were performed from the perspective of reasoned action theories and planned behavior. In both theories, behavioral intentions are seen as the closest determinant of behavior. Behavioral intentions are proposed not just to be affected by people's attitude to behavior, but by subjective norms defined as perceived social pressure from other individuals that people consider to be important to perform the behavior (Terry, Hogg & McKimmie, 2000). In other words, the attitude forming about a concept or object does not just occur in a way free from the external environment, but at the same time recalls the presence of social effects (family, school, group...). Behavior is also used in a third way in attitude research. Instead of behavior as determinant or outcome, it is used as a marker of attitude or in other words, it is stated to be a tool to measure attitude. For assumed structures where attitudes cannot be directly observed, the researcher attaches meaning to a person's attitudes based on the observable behavior performed by the individual (Jaccard & Blanton, 2005). At this point, it is necessary to investigate how attitudes form.

Attitudes can be excavated by learning paths, as with our behavior. 'In fact, attitudes are a part of the acquired personality traits of an individual and like other acquired personality traits can be learned by classic or acquired conditioning or observing and mimicking models' (Morgan, 2011, p. 336). Kağıtçıbaşı and Cemalcılar (2014, p. 143) stated that attitudes may form at early ages and that attitudes reflect 'social norms and cultural values.' Further factors causing formation of attitudes can be listed as experience, learning from the social environment and through media. In relation to this topic, Tavşancıl (2014, p. 80) mentioned that until the adolescent period attitudes are largely shaped by the effect of families, while with adolescence they begin to be affected more by attitudes in the social environment. Additionally, after the 20s, attitudes begin to 'crystallize' and it is stated they become more rigid and changing attitudes becomes more difficult.

One of the important elements in learning and academic success in terms of educational sciences, attitudes are affected by or affect human behavior and are one of the variables in direct or indirect relationships with behavior. For this reason, at any point in the educational process attitudes may allow us the opportunity to predict the positive or negative reaction of an individual/student within this process. For this reason, the attitude of individuals/students may assist in overcoming possible problems that may emerge in displaying the desired acquirement and behavior. In other words, just as positive attitudes may provide motivation to display the expected behavior, negative attitudes may cause the whole process to be reviewed and it may take time for the problem to be solved. If we wanted to assess with a simple approach, the knowledge and feelings of a student during the educational process provide us with a priori information about the student's academic success. As a result, as in other disciplines, the concept of attitude has an important place in education studies.

Education, as previously emphasized, requires a process and education science studies with the attitude concept as research topic appear to be founded on the assertion that attitude transforms to action or is a predisposition toward behavior, as in the two approaches mentioned above (Canakay, 2007; Karakılıç, 2009; Konakcı, 2010; Tosun, 2011; Turan, 2015; Koçyiğit, 2019; Öztürk, 2012; Uçaner, 2011; Malim, 1997; Rajeci, 1990; Verešová & Malá, 2016; Burns & Dobson, 1983; Jain, 2014; Albarracín et al., 2005; Eagly & Chaiken, 1993). One of the most important reasons for this is that there are studies revealing that positive attitudes of students to a topic or lesson ensure high academic success in that topic or lesson. According to Zimbardo and Leippe (1991, p32), these three components may be very closely interrelated. Cognition and attitude are linked to what we call the mental representation of an object. Emotional responses and open behavior occur when an object comes to mind and new information may be added to the representation of the object. For this reason, the attitude related to an object or topic comprises the individual's response system characterized by behavior, cognition and emotions. The cognitive component includes things a person believes that may be correct or mistaken; the emotional component is all feelings related to the attitude object that affect evaluation; and the behavioral component reflects the individual's true behavior (Burns & Dobson, 1983, p. 369).

The behavior changes expected after learning may create changes in the attitudes related to the topic or concept of the individual, just as these changes may occur in different situations. For example, in addition to the student's attitude to a lesson, situations like the physical environment, teaching techniques used, and teacher's approach may cause behavior changes. In relation to this topic, Aronson, Wilson and Akert (2010) investigated attitude changes by changing behavior to change attitudes in four groups; re-cognitive conflict concept, communication for persuasion and attitude changes, feeling and attitude changes and trust in the person's own thoughts and attitude changes. Additionally, they stated that genetic factors and social experience shape attitudes and cause different attitudes (Aronson, Wilson & Akert, 2010, p. 357). However, behavior is due to many diverse factors and may be affected by these. Attitude theoreticians have a tendency to emphasize structures like beliefs, targets, attitude, effect, intentions, habits, personality and automaticity when creating behavior models. However, many social scientists trust more peripheral structures to explain behavior. Among these, factors like genetic effects, biological effects, media effects, family effects, social effects, school effects, gender effects, religious effects, cultural effects, economic effects, political effects and developmental effects may be listed (Jaccard & Blanton, 2005). As can be seen, attitude concept studies are a controversial topic

currently due to the components they contain and the multitude of variables, many assertions are disproven or supported on a dialectic basis due to the nature of science during efforts to solve the problem of definitely predicting the behavior of an individual. No matter the degree to which attitude is not behavior but is assumed to be a tendency toward behavior as by Jaccard and Blanton (2005), the need for the presence of observable behavior in order to be able to measure attitude is accepted, again by Jaccard and Blanton. In other words, the only topic on which consensus has been reached about the concept of attitude is the need for a behavior (verbal or action) to be able to measure attitude.

In the context of explanations related to the concept of attitude, the topic of the study of playing an instrument is included in the educational process and results in the active output of performance; for this reason, it is thought that investigating the attitude concept separate from the debates above will be convenient and measurement will assist in reaching more reliable conclusions. In other words, even performing during the instrument education process will provide more clarity about the levels of the emotional, cognitive and behavior dimensions of attitudes toward playing the instrument in the individual along with the time factor. However, positive attitudes increase academic success, while negative attitudes reduce it. In this context, the need is felt to know the attitude levels of individuals receiving education for baglama, one of the important instruments in Turkish music culture, and it appears important to develop a measurement device in order to measure 'attitudes to playing baglama' which has not been a topic of previous studies.

Problem Statement

The problem in this research can be stated as the question: 'Is the attitude to playing baglama scale that will be developed valid and reliable?

Aim and Significance of the Research

The aim of the research is to develop a measurement device which can identify the attitudes related to playing baglama among preservice music teachers.

Preservice teachers who know musical culture of the society in which they live and its place in social life are considered to provide an important function in students acquiring the desired behavior. The change based on this approach in the music education undergraduate program in recent times (not just baglama education, the addition of lessons like Turkish music theory and listening, Turkish folk music choir, Turkish folk music types and form information) supports this approach. However, studies in the educational field about measurement devices related to baglama and Turkish folk music education are limited. As playing baglama is a process and an educational output involving cognitive, affective and behavioral elements, this study is important in terms of revealing the student levels of concepts involving these three elements.

In this context, literature screening did not encounter an attitude scale developed for 'playing baglama.' In spite of the inclusion of baglama, an important element of Turkish music culture, in music teacher training programs for many years, the attitude levels related to playing baglama among students are unknown. This situation makes it necessary to know the attitudes of preservice teachers, an important element in Turkish music culture in terms of the role they will play in musical development of students, about playing the baglama. This is considered important in order to reveal the reasons for negative attitudes among preservice teachers with negative attitudes and in terms of time to ensure transformation to positive attitudes.

METHOD/MATERIALS

Research Model

In the research, the descriptive screening model from general research types was used for the scale development processes.

Study Group

The study group for the research comprised 2nd, 3rd and 4th year students in the Music Education branch attending Mehmet Akif Ersoy University, Pamukkale University, Niğde Ömer Halis Demir University, Necmettin Erbakan University, İnönü University, Cumhuriyet University, and Kastamonu University during the 2019-2020 educational year.

Table 1. Distributions related to demographic information of participants

Variable	Sub-variable	f	%
University	Mehmet Akif Ersoy University	91	21.8
	Pamukkale University	59	14.1
	Niğde Ömer Halis Demir University	62	14.8
	Necmettin Erbakan University	76	18.2
	İnönü University	49	11.7
	Cumhuriyet University	59	14.1
	Kastamonu University	22	5.3
Gender	Female	240	57.4
	Male	178	42.6
Class level	2nd year	141	33.7
	3rd year	137	32.8
	4th year	140	33.5
Total		418	100

Data Collection Tools

When developing the Attitude to Playing the Baglama Scale, the relevant literature was screened and attitude scales developed by Sözen (2012) and Algı (2013) about school instrumental baglama lessons were investigated. Later, attitude scales related to other instruments and music were investigated (Kaya, 2011; Nacakçı, 2006; Tufan & Güdek, 2008a; Tufan & Güdek, 2008b; Yıldırım, 2009; Saygı, 2009; Canakay, 2007; Özmenteş, 2007; Doğan, 2017; Yalçınkaya & Eldemir, 2013; Şen, 2011; Kocabaş, 1997; Uçaner, 2011) and the literature was used to create a pool of 50 items with 5-point Likert type. In line with expert opinions given on the Expert Opinion Form, the number of items was lowered from 50 to 37. The scale prepared for implementation was applied to the study group. After application validity and reliability processes were performed.

The scale had KMO value of .960 which is close to perfect levels, while the Bartlett's test value was significant at $p < 0.05$ so factor analysis was performed. After factor analysis, 15 items did not have suitable load values and were removed from the scale. Later explanatory factor analysis was performed and the scale was gathered into 3 factors which appeared to explain 70.572% of the total variance of the scale. After confirmatory factor analysis, 2 items were removed from the scale. The Cronbach alpha reliability value was identified to be .960. Finally, the Attitude to Playing Baglama Scale comprised 20 items in total in three factors of 'Value given to Playing Baglama' (Value), 'Adjustment to Playing Baglama' (Adjustment) and 'Interest in Playing Baglama' (Interest).

Analysis of Data

Data obtained within the scope of the research were analyzed using SPSS 22 and AMOS 22 programs. Frequency and percentage were used for variables on the Personal Information Form. Bartlett's sphericity test was used to test normality, with Kaiser-Meyer-Olkin (KMO) was applied for the suitability of the sample size. For construct validity, the Attitude to Playing Baglama Scale developed by the researcher was analyzed with exploratory factor analysis. After suitable results, the Varimax conversion process was applied for confirmatory factor analysis and the Cronbach alpha coefficient was calculated for the internal consistency of the scale. Based on these analyses, items were removed from the scale developed by the researcher and mean factor points were calculated with the remaining items. The s-Z scores for the points were obtained, and 29 values outside the interval -3 to +3 were removed from the data set. The scale used in the research is a 5-point Likert type scale, so arithmetic mean was calculated for the total points that can be obtained from the scales ($5-1=4$; $4:5=0.80$). Points obtained for the scales were assessed as 1.00-1.79 low levels, 1.89-2.59 lower moderate levels, 2.60-3.39 moderate levels, 3.40-4.19 upper moderate levels and 4.20-5.00 high levels and are shown in Table 2.

Table 2. Arithmetic mean values

1.00-1.79	Low level
1.80-2.59	Lower moderate level
2.60-3.39	Moderate level
3.40-4.19	Upper moderate level
4.20-5.00	High level

FINDINGS

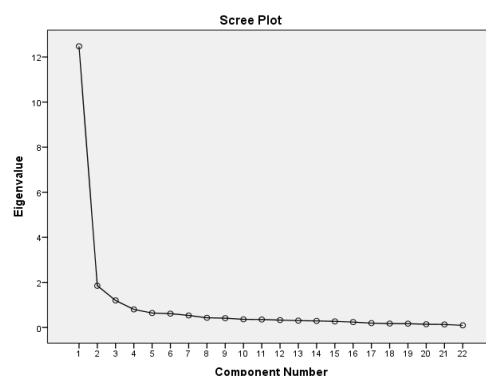
As mentioned in a previous section, after literature screening, item pool creation and expert opinions for scope validity, 37 items were applied to participants. In order to apply construct validity to the scale abiding by scope validity; in other words, for data to be suitable for factor analysis, preconditions include the measurement intervals stated for KMO and Bartlett's test. For this reason, to ensure construct validity, firstly Kaiser-Meyer-Olkin and Bartlett's test should be applied to determine suitability of the sample size for factor analysis and the power of relationships. The results are given in Table 5.

Table 3. Exploratory factor analysis KMO and Bartlett's Test results for Attitude to Playing Baglama Scale

Kaiser-Mayer-Olkin (KMO)		.960
	χ^2	8200.616
Bartlett's Test	df	231
	p	.000

The KMO value represents whether the sample size is sufficient for use in factor analysis. As seen in Table 5, KMO values above .800 show the sample size is close to perfect levels (Aksu et al., 2017, p. 9; Altunışık et al., 2007, p. 226) and in this research the KMO value for the Attitude to Playing Baglama Scale was .960 which is close to perfect. If the Bartlett's test value is significant, this is a marker that the scale can be separated into factors (Aksu et al., 2017; p.10; Altunışık et al., 2007, p.230). In this research, the Bartlett's test value appeared to be significant for exploratory factor analysis of the Attitude to Playing Baglama Scale ($\chi^2(231) = 8200,6116$; $p < 0.05$).

After the KMO and Bartlett's test results abided by suitable values stated in the literature, to reveal the factors, in other words to find the smallest factor number which is the best indicator of groups among items (Pallant, 2016, p.201), the most commonly used methods of the scree plot (Figure 1) and variance values (Table 6) were applied

**Figure 1. Scree plot for exploratory factor analysis related to Attitude to Playing Baglama Scale**

With the aim of determining the factor number, the scree plot is a frequently used graph. The point at which the vertical slope becomes horizontal is accepted as the appropriate factor number (Özdamar 2013b, p.221; Altunışık et al., 2007, p. 222, Çokluk et al., p. 193). As seen in Figure 1, the graph flattens out between the numbers 3-4.

Table 4. Variance values for Exploratory Factor Analysis related to Attitude to Playing Baglama Scale

Factor	Eigen value
Factor 1	12.475
Factor 2	1.850
Factor 3	1.201

The eigenvalues in exploratory factor analysis are used as an alternative to the scree plot to determine suitable factor numbers and as verifier. The number of factors with eigenvalues above 1 appears suitable for the number of factors (Çokluk et al., p. 192; Altunışık et al., 2007, p. 226). When Table 6 is investigated, factor 1 has eigenvalue 12.475, factor 2 has eigenvalue 1.850 and factor 3 has eigenvalue 1.201. Considering both the scree plot and the eigenvalues, it was decided that it would be appropriate to create 3 factors for the scale.

Factor analysis is used as a data reduction method (Pallant, 2016, p. 199). At this point, to name and interpret the determined factors, the axis rotation process was applied, with the frequently chosen vertical rotation method of varimax applied as shown in Table 7.

Table 5. Factor load values for exploratory factor analysis for the Attitude to Playing Baglama Scale

Items	Factor 1	Factor 2	Factor 3	Explained variance
Item 11	.513			30.429
Item 12	.765			
Item 13	.766			
Item 14	.646			
Item 15	.664			
Item 16	.702			
Item 18	.675			22.558
Item 22		.705		
Item 23		.772		
Item 24		.701		
Item 25		.761		
Item 26		.799		
Item 27		.847		17.584
Item 28		.859		
Item 29		.729		
Item 30		.730		
Item 31			.694	
Item 32			.772	
Item 33			.736	17.584
Item 34			.673	
Item 35			.725	
Item 36			.675	
Total				70.572

In the first stage of factor analysis, overlapping items (included in more than one factor and with factor loads less than 0.1) and items with factor loads below 0.30 were removed from the scale (Altunışık et al., 2007, s. 226, Çokluk et al., s. 194). These

items were items numbered 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 17, 19, 20, 21, and 37. After removing 15 items from the scale, exploratory factor analysis was applied again. As a result of the analysis, the scale was identified to cluster in 3 factors. Factor 1 (value given to playing baglama) comprised items 11, 12, 13, 14, 15, 16 and 18, factor 2 (adjustment to playing baglama) comprised items 22, 23, 24, 25, 26, 27, 28, 29 and 30 and factor 3 (interest in playing baglama) comprised items 31, 32, 33, 34, 35 and 36. The factor loads in factor 1 varied from .513 to .766, factor loads in factor 2 varied from .701 to .859, and factor loads in factor 3 varied from .673 to .772. The variance explained by factor 1 was 30.429%, the variance explained by factor 2 was 22.558%, the variance explained by factor 3 was 17.572% and the variance explained by the whole scale was 70.572%. Factor 1 measures the value given to the baglama and ensuring development in personal and professional terms, factor 2 measures importance and adjustment to baglama in social life and factor 3 measures interest shown in the baglama.

To measure the degree of homogeneity for each factor, the item-total correlations were calculated for each item and the t values for the differences in item points for the lower and upper 27% groups were examined for differential validity (Table 8). Another marker of homogeneity of internal consistency was calculated with the alpha coefficient and the analysis results are presented in Table 9.

Table 6. Item analysis results for Attitude to Playing Baglama Scale

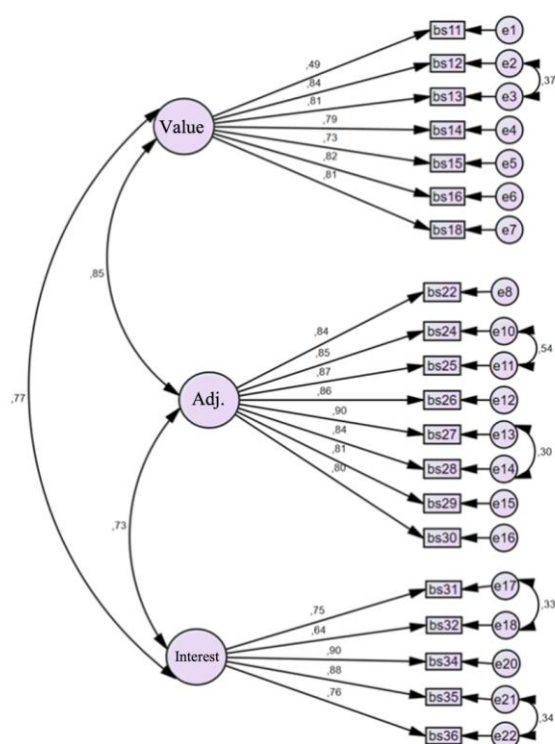
Items	Item total correlations	t (Upper 27% – Lower 27%)	p (Upper 27% – Lower 27%)
Item 11	.455	-9.841	.000
Item 12	.775	-20.497	.000
Item 13	.734	-17.312	.000
Item 14	.730	-19.489	.000
Item 15	.661	-17.817	.000
Item 16	.746	-21.987	.000
Item 18	.741	-19.992	.000
Item 22	.808	-30.614	.000
Item 23	.812	-28.076	.000
Item 24	.852	-31.588	.000
Item 25	.836	-30.847	.000
Item 26	.789	-25.859	.000
Item 27	.815	-35.055	.000
Item 28	.749	-24.776	.000
Item 29	.750	-26.081	.000
Item 30	.742	-24.600	.000
Item 31	.695	-16.782	.000
Item 32	.541	-11.765	.000
Item 33	.393	-6.690	.000
Item 34	.774	-22.431	.000
Item 35	.749	-20.438	.000
Item 36	.619	-13.407	.000

When Table 8 is investigated, the mean values for items on the Attitude to Playing Baglama Scale in the lower 27% group and upper 27% group differed by a significant level ($p < 0.05$) and the item total correlations varied from .393 to .852. According to these results, the scale appears to have distinct level of difference for those receiving high points and those receiving low points.

Table 7. Reliability test results for Attitude to Playing Baglama Scale

Factor	Item numbers	Cronbach's Alpha
Value	7	.900
Adjustment	9	.955
Interest	6	.901
Total attitude	22	.961

When Table 9 is investigated, the value, adjustment and interest factors and the total scale points for the Attitude to Playing Baglama Scale appear to be reliable at high levels (Özdamar 2013a, p. 555).

**Figure 2. Confirmatory Factor Analysis Graphic for Attitude to Playing Baglama Scale****Table 8. Assessment of fit indices for confirmatory factor analysis of the Attitude to Playing Baglama Scale**

chi-square/sd	RMSEA	CFI	NFI	GFI	AGFI	RMR	SRMR
3.123	.071	.953	.933	.900	.864	.068	.040

Acceptable values: chi-square/sd $\leq$ 5, RMSEA $\leq$ 0.09, GFI $\geq$ 0.90, RMR $\leq$ 5 (Özdamar, 2013a), NFI $\geq$ 0.90, CFI $\geq$ 0.90, AGFI $\geq$ 0.85), SRMR $\leq$ 0.10 (Bayram, 2010).

When the goodness of fit indices related to confirmatory factor analysis of the attitude to playing baglama scale are investigated, the obtained values appear to have acceptable level of fit (chi-square/sd=3.123; RMSEA=.071; CFI=.953; NFI=.933; GFI=.900; AGFI=.864; RMR=.068; SRMR=.040). These values show the attitude to playing baglama scale is a consistent measurement device.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

As a result of the research, the 'attitude to playing baglama scale' developed by the researcher was found to abide by scope validity based on expert opinions and factor analysis was performed to test the construct validity. As a result of factor analysis, the scale was seen to abide by construct validity. To test reliability, the alpha coefficient was calculated and the scale was concluded to be reliable. In conclusion, the attitude to playing baglama scale developed by the researcher was concluded to be a valid and reliable measurement device.

The data obtained in this research show the attitude to playing baglama scale is a valid and reliable measurement device. The attitude to playing baglama scale comprises 20 items and was seen to successfully reflect the interest, value and adjustment levels related to playing baglama of preservice music teachers. In this context, the scale developed in the research is considered to fill a significant gap in the field in terms of being the first to measure attitude to playing baglama among preservice teachers.

The preservice teachers were found to have upper moderate levels of attitude. Sözen (2012) found that preservice teachers had upper moderate levels of attitude on the attitude to baglama lessons scale applied to preservice music teachers. For the attitude scale applied by Algi (2013), preservice music teachers had positive attitudes toward baglama lessons. In addition to these studies limited to baglama, a scale applied to piano lessons by Karabulut (2009) concluded that preservice music teachers had positive attitudes to piano lessons. The study by Kaya (2011) found preservice music teachers received high points on an attitude to choir lessons scale. Konaklı (2010) observed that preservice music teachers had positive attitudes toward individual instrument education lessons. Brown (1996) compared attitude toward instrument education among 4th, 5th, 6th and 7th class students and stated that the attitudes of 5th class students were positive, while the attitude levels reduced as the class level increased. Fortney (1992) applied the instrumental music attitude inventory to high school students in music groups and observed students displayed positive attitudes. A study by Girgin (2020) found that fine arts high school students had high attitude levels toward individual instrument lessons. Based on these explanations, the attitude levels to playing baglama were similar to attitudes in other studies.

With the increasing Turkish folk music and baglama lesson hours in the undergraduate music teaching program, the importance of knowing the attitude levels of preservice teachers to playing this instrument has increased. For both program planners and lecturers, the interest, adjustment, value, knowledge and skill levels about playing baglama of preservice teachers will be helpful in their ability to achieve success in the program, problems that may be encountered and planning solution approaches to this problem. In the context of baglama education lessons, it will be possible to find answers to questions of whether preservice teachers achieve the desired success with the lesson content or not, whether the predicted attitude levels increase or not and whether the desired knowledge and skill competency are achieved or not with this scale. Additionally, other inevitable contributions are that data will allow preservice teachers to assess themselves and gain knowledge, and allow lecturers to identify requirements like needs, expectations and level in relation to baglama teaching.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, author-ship, and/or publication of this article.

Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

This research was conducted following the approval of the Non-Interventional Clinical Trials Ethics Committee at Burdur Mehmet Akif Ersoy University, dated 03/11/2021 and numbered G0 2021/355.

REFERENCES

- Ajzen, I. (1988). *Attitudes, personality, and behavior*. Illinois: Dorsey Press.
- Ajzen, I. & Fishbein, M. (2005). The Influence Of Attitudes On Behavior. Albarracín, D., Johnson, B. T., Zanna, M. P. (Eds.), *The Handbook of Attitudes* (p. 173-221). Mahwah, New Jersey: Lawrence Erlbaum Associates.
- Aksu R., Eser M. T. ve Güzeller, C. O. (2017). *Açımlayıcı ve Doğrulayıcı Faktör Analizi ile Yapısal Eşitlik Modeli Uygulamaları*. Ankara: Detay Yayıncılık.

- Albarracin, D., Zanna, M. P., Johnson, B. T. & Kumkale, G. T. (2005). Attitudes: Introduction and Scope. D. Albarracin, B. T. Johnson, M. P. Zanna, (Eds.), *The Handbook of Attitudes* (p. 3-19). Mahwah, New Jersey: Lawrence Erlbaum Associates.
- Algı, S. (2013). *Müzik Öğretmeni Yetiştiren Kurumlarda Geleneksel Türk Sanat Müziği Destekli Bağlama Öğretiminin Öğrencilerin Bağlama Çalma Becerisi ve Tutumlarına Etkisinin İncelenmesi* (Yayınlanmamış Doktora Tezi). Necmettin Erbakan Üniversitesi Eğitim Bilimleri Enstitüsü, Konya.
- Altunışık R., Coşkun R., Bayraktaroğlu S. ve Yıldırım E. (2007). *Sosyal Bilimlerde Araştırma Yöntemleri SPSS Uygulamalı*. İstanbul: Sakarya Yayıncılık.
- Aronson, E., Wilson, T. D. & Akert, R. M. (2010). *Sosyal Psikoloji*. (O. Gündüz, Çev.). İstanbul: Kaknüs Yayınları.
- Banaji, M. R. & Heiphetz, L. (2010). Attitudes. S. T. Fiske, D. T. Gilbert, & G. Lindzey (Eds.), *Handbook of Social Psychology* Fifth Edition. (Volume 1, p. 353-393). New Jersey: John Wiley & Sons, Inc.
- Bayram, N. (2010). *Yapısal Eşitlik Modellemesine Giriş AMOS Uygulamaları*, Ezgi Kitabevi.
- Brown, M. J. (1996). *Student attitude toward instrumental music education during the first year of instruction*. (Doctoral Dissertation). The Ohio State University, Ohio.
- Burns, R. B. & Dobson, C. B. (1983). *Experimental Psychology Research Methods and Statistics*. Second Edition. Lancaster: MTP Press.
- Canakay, E. U. (2007). Aktif Öğrenmenin Müzik Teorisi Dersine İlişkin Akademik Başarı, Tutum, Özyeterlik Algısı ve Yüklemler Üzerindeki Etkileri (Yayınlanmamış Doktora Tezi). Dokuz Eylül Üniversitesi Eğitim Bilimleri Enstitüsü, İzmir.
- Cüceloğlu, D. (2006). *İnsan ve Davranışı* (15. Basım). İstanbul: Remzi Kitabevi.
- Çokluk Ö., Şekercioğlu G. ve Büyüköztürk Ş. (2010). *Sosyal Bilimler İçin Çok Değişkenli İstatistik: SPSS ve LISREL Uygulamaları*. Ankara: Pegem Akademi.
- Doğan, M. (2017). *Müzik Öğretmeni Yetiştiren Kurumlardaki Öğrencilerin Keman Dersindeki Başarı Düzeylerini Yordayan Öğrenmeye İlişkin Özellikler* (Yayınlanmamış Doktora Tezi). Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü, Ankara.
- Eagly, A. H. & Chaiken, S. (1993). *The Psychology Of Attitudes*. Orlando, FL: Harcourt Brace Jovanovich.
- Fortney, P. M. (1992). The Construction and Validation of an Instrument to Measure Attitudes of Students in High School Instrumental Music Programs. *Contributions to Music Education*, 19, 32-45.
- George, D. & Mallery, M. (2010). *SPSS for Windows Step by Step: A Simple Guide and Reference*. 17.0 update (10a ed.) Boston: Pearson.
- Girgin, D. (2020). Motivation, self-efficacy and attitude as predictors of burnout in musical instrument education in fine arts high schools. *Eurasian Journal of Educational Sciences*, 85, 93-108.
- Hair, J. F., Black, W. C., Babin, B. J. & Anderson, R. E. (2019). *Multivariate Data Analysis*. (Eighth Edition). Hampshire: Cengage Learning.
- İnceoğlu, M. (2011). *Tutum, Algı, İletişim*. (6. Baskı). İstanbul: Siyasal Kitabevi.
- Jaccard, J. & Blanton, H. (2005). The Origins and Structure of Behavior: Conceptualizing Behavior in Attitude Research. D. Albarracin, B. T. Johnson, M. P. Zanna, (Eds.), *The Handbook of Attitudes* (p. 125-172). Mahwah, New Jersey: Lawrence Erlbaum Associates.
- Jain, V. (2014). 3D Model Of Attitude. *International Journal of Advanced Research in Management and Social Sciences*, 3(3), 1-12.
- Kağıtçıbaşı, Ç. ve Cemalcılar, Z. (2014). *Dünden Bugüne İnsan ve İnsanlar Sosyal Psikolojiye Giriş* (16. Basım). İstanbul: Evrim Yayınevi.
- Karabulut, G. (2009). *Eğitim Fakültesi Müzik Eğitimi Anabilim Dalı 1. Ve 3.Sınıf Öğrencilerinin Piyano Dersine Yönelik Tutumlarının İncelenmesi*. (Yayınlanmamış Yüksek Lisans Tezi). Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.
- Karakılıç, M. (2009). *Beden Eğitimi Dersi İçin Hazırlanan Tutum Ölçeğinin Psikometrik Kuramlar Açısından İncelenmesi* (Yayınlanmamış Doktora Tezi). Ankara Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.
- Kaya, Z. (2011). *Koro Eğitiminde Yapılandırmacı Yaklaşımın Tutum, Öz-Yeterlik Algısı ve Akademik Başarıya Etkisi* (Yayınlanmamış Doktora Tezi). İnönü Üniversitesi Eğitim Bilimleri Enstitüsü, Malatya.
- Kocabaş, A. (1997). Temel Eğitim II. Kademe Öğrencileri İçin Müziğe İlişkin Tutum Ölçeğinin Geçerlik ve Güvenirlik Çalışması. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi* 13, 141-145.
- Koçyiğit, Ş. (2019). *Stem Odaklı Öğretim Süreçlerinde Öğrencilerin Matematiksel Muhakeme, Matematiğe Yönelik Tutum ve Özyeterliklerinin İncelenmesi* (Yayınlanmamış Doktora Tezi). Eskişehir Osmangazi Üniversitesi Eğitim Bilimleri Enstitüsü, Eskişehir.
- Konakçı, N. (2010). *Eğitim Fakültesi Güzel Sanatlar Eğitimi Bölümü Müzik Eğitimi Anabilim Dalı Öğrencilerinin Bireysel Çalgı Eğitimi Dersine Yönelik Tutumlarının İncelenmesi* (Yayınlanmamış Yüksek Lisans Tezi). Marmara Üniversitesi Eğitim Bilimleri Enstitüsü, İstanbul.
- Malim, T. (1997). *Social Psychology*. (Second Edition). New York: Palgrave.

- Malim, T. & Birch, A. (1998). *Introductory Psychology*. New York: Palgrave.
- Morgan, C. T. (2011). *Psikolojiye Giriş*. S. Karakaş, R. Eski (Ed.) 19. Baskı. Konya: Eğitim Akademi Yayınları.
- Nacakçı, Z. (2006, Nisan). İlköğretim Öğrencilerinin Müzik Dersine İlişkin Tutumları. *Ulusal Müzik Eğitimi Sempozyumu*'nda sunulmuş bildiri, Pamukkale Üniversitesi, Denizli.
- Oskamp, S. & Schultz P. W. (2005). *Attitudes and opinions* (Third Edition). Mahwah, New Jersey: Lawrence Erlbaum Associates.
- Özdamar, K. (2013a). *Paket Programlar ile İstatistiksel Veri Analizi – 1*, MINITAB 16 – IBM SPSS 21. Eskişehir: Nisan Kitapevi.
- Özdamar, K. (2013b). *Paket Programlar ile İstatistiksel Veri Analizi – 2*, MINITAB 16 – IBM SPSS 21. Eskişehir: Nisan Kitapevi.
- Özmenteş, S. (2007). *Çalgı Çalışma Sürecinde Özdüzenlemeli Öğrenme ile Duyuşsal Özellikler ve Performans Düzeyi İlişkileri* (Yayımlanmamış Doktora Tezi). Dokuz Eylül Üniversitesi Eğitim Bilimleri Enstitüsü, İzmir.
- Öztürk, Ö. (2012). *İlköğretim Altıncı Sınıf Müzik Dersinde Kullanılan Tam Öğrenme Modeli'nin Öğrencilerin Tutum ve Başarılarına Etkisi* (Yayımlanmamış Doktora tezi). Abant İzzet Baysal Üniversitesi Eğitim Bilimleri Enstitüsü, Bolu.
- Pallant, J. (2016). *SPSS Kullanma Klavuzu, SPSS ile Adım Adım Veri Analizi*. (S. Balcı, B. Ahi, Çev.). Ankara: Anı Yayıncılık.
- Prislin, R. & Crano, W. D. (2008). Attitudes and Attitude Change The Fourth Peak. R. Prislin, & W. D. Crano, (Ed.). *Attitudes and Attitude Change* (p. 3–18). New York: Psychology Press.
- Rajecki, D. W. (1990). *Attitudes* (2nd ed.). Sunderland, MA: Sinauer.
- Saygı, C. (2009). *Aktif Öğrenmenin Müzik Tarihi Dersine İlişkin Başarı, Tutum ve Özyeterlik Üzerindeki Etkisi* (Yayımlanmamış Doktora Tezi). Dokuz Eylül Üniversitesi Eğitim Bilimleri Enstitüsü, İzmir.
- Sözen, İ. (2012). *İşbirlikli Öğrenme Yaklaşımı ile Yapılan Toplu Bağlama Öğretiminin Performans ve Tutuma Etkisi* (Yayımlanmamış Doktora Tezi). Abant İzzet Baysal Üniversitesi Eğitim Bilimleri Enstitüsü, Bolu.
- Şen, Y. (2011). *Müzik Öğretmenliği Öğrencilerinin "Geleneksel Türk Müziği Dersleri"ne İlişkin Tutumlarının Çeşitli Değişkenler Açısından İncelenmesi* (Yayımlanmamış Doktora Tezi). Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü, Ankara.
- Tavşancıl, E. (2014). *Tutumların Ölçülmesi ve SPSS ile Veri Analizi* (5. Basım). Ankara: Nobel Akademik Yayıncılık.
- Terry, D. J., Hogg, M. A. & McKimmie, B. M. (2000). Attitude-Behaviour Relations: The Role Of In-Group Norms And Mode Of Behavioural Decision-Making. *British Journal Of Social Psychology* 39, 337-361.
- Tezbaşaran, A. (2008). Likert Tipi Ölçek Hazırlama Kılavuzu. E-kitap. https://www.academia.edu/1288035/Likert_Tipi_%C3%96l%C3%A7ek_Haz%C4%B1rlama_K%C4%B1lavuzu sayfasından erişilmiştir. (Erişim Tarihi: 12.12.2019).
- Tosun, Z. D. (2011). *Biyoloji Dersine Yönelik Tutum Ölçeği Geliştirilmesi* (Yayımlanmamış Doktora Tezi). Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.
- Tufan, E. ve Güdek, B. (2008a). Piyano Dersi Tutum Ölçeğinin geliştirilmesi. *Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi*, 28(1), 75-90.
- Tufan, E. ve Güdek, B. (2008b). Müzik Öğretmenliği Mesleğine Yönelik Tutum Ölçeğinin Geliştirilmesi. *Türk Eğitim Bilimleri Dergisi*, 6(1), 25-40.
- Turan, Z. (2015). Beden Eğitimi Öğretmen Adayları İçin Halk Oyunları Dersi Tutum Ölçeğinin Geliştirilmesi. *YYÜ Eğitim Fakültesi Dergisi*, 12(1), 202-222.
- Uçaner, B. (2011). *Eğitim Fakültesi Müzik Eğitimi Anabilim Dalı Öğrencilerinin Türk Müzik Tarihi Dersine Yönelik Tutum ve Akademik Başarıları Arasındaki İlişkinin Farklı Değişkenler Açısından Değerlendirilmesi* (Yayımlanmamış Doktora Tezi). Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.
- Verešová, M. & Malá, D. (2016). Attitude Toward School And Learning And Academic Achievement Of Adolescents. *7th International Conference On Education and Educational Psychology* (p. 870-876). Greece.
- Yalçinkaya, B. ve Eldemir, A. C. (2013). Bireysel Çalgı Dersine İlişkin Tutum Ölçeğinin Geliştirilmesi. *Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi* 10(21), 29-36.
- Yıldırım, K. (2009). *Kodaly Yönteminin İlköğretim Öğrencilerinin Keman Çalma Becerisi, Özyeterlik Algısı ve Keman Çalmaya İlişkin Tutumları Üzerindeki Etkisi* (Yayımlanmamış Doktora Tezi). Dokuz Eylül Üniversitesi Eğitim Bilimleri Enstitüsü, İzmir.
- Zanna, M. P. & Rempel, J. K. (1988). Attitudes: A New Look At An Old Concept. D. Bar-Tal & A. W. Kruglanski (Eds.). *The Social Psychology Of Knowledge* (p. 315–334). New York: Cambridge University Press.
- Zimbardo, P. G. & Leippe, M. R. (1991). *The Psychology of Attitude Change and Social Influence*. Philadelphia: Temple University Press.



| Research Article / Araştırma Makalesi |

Investigating the Relationship Between Teachers' Digital Technology Competencies and Their Digital Literacy Levels

Öğretmenlerin Dijital Teknoloji Yeterlikleri ve Dijital Okuryazarlık Düzeyleri Arasındaki İlişkinin İncelenmesi

Osman ÖZDEMİR¹

Keywords

1. Digital Competence
2. Digital Literacy
3. Teacher's Technology Skills
4. Correlation Analysis
5. Education Technology Competencies

Anahtar Kelimeler

1. Dijital Yeterlilik
2. Dijital Okuryazarlık
3. Öğretmenlerin Teknoloji Becerileri
4. Korelasyon Analizi
5. Eğitim Teknolojisi Yeterlilikleri

Received/Başvuru Tarihi
19.09.2024

Accepted / Kabul Tarihi
25.07.2025

Abstract

Purpose: Understanding the interaction between digital technology competence and digital literacy is important for improving educational outcomes in the digital age. The purpose of this study is to examine the relationship between teachers' digital technology competencies and digital literacy levels. In addition, the study aims to investigate whether these variables differ significantly based on gender and the education level at which teachers work, and whether digital competence significantly predicts digital literacy.

Design/Methodology/Approach: Correlation research model was used in the study and 354 teachers selected from different regions of Turkey by purposive sampling method constituted the sample group. The research data were collected using the 'Teacher Digital Competence Scale' to determine the digital competence levels of teachers and the 'Digital Literacy Scale' to determine their digital literacy levels. Descriptive statistics and parametric tests were used to analyze the data.

Findings: The findings of the study revealed that teachers' digital competence and digital literacy levels were high. While there was a significant difference in terms of digital literacy according to gender variable, no significant difference was observed in terms of digital competence. ANOVA results revealed that there were no significant differences in terms of digital cognitive and technical literacy sub-dimensions and overall digital literacy level according to the education level of the teachers; however, high school teachers had higher digital competence scores compared to primary school teachers. Correlation analysis showed that there is a strong and positive relationship between digital literacy and digital competence. Simple linear regression analysis showed that digital literacy significantly predicted digital competence and explained 45% of its variance.

Highlights: As a result of this study, it is recommended that targeted professional development programs focusing on enhancing digital competence and literacy be implemented for teachers, particularly at the primary school level. These programmes should be implemented especially in regions and education levels where digital technology and digital literacy skills are lower. In order to reduce the digital literacy gap between genders, gender-sensitive digital skills development workshops should be organised for teachers and this gap should be prevented from leading to inequalities in digital education. In the light of the finding that digital literacy significantly predicts digital competence, it is important to make digital literacy training compulsory for all teachers.

Öz

Çalışmanın amacı: Dijital teknoloji yeterliliği ve dijital okuryazarlık arasındaki etkileşimi anlamak, dijital çağda eğitim çıktılarına iyileştirmek açısından önemlidir. Bu çalışmanın amacı, öğretmenlerin dijital teknoloji yeterlilikleri ile dijital okuryazarlık düzeyleri arasındaki ilişkiyi incelemektir. Ayrıca, bu değişkenlerin cinsiyete ve öğretmenlerin çalıştıkları eğitim düzeyine göre anlamlı bir farklılık gösterip göstermediği ve dijital yeterliliğin dijital okuryazarlığı anlamlı bir şekilde yordayıp yordamadığı araştırılmaktadır.

Materyal ve Yöntem: Araştırmada korelasyon araştırma modeli kullanılmış ve Türkiye'nin farklı bölgelerinden amaçlı örnekleme yöntemiyle seçilen 354 öğretmen örneklem grubunu oluşturmuştur. Araştırma verileri, öğretmenlerin dijital yeterlilik düzeylerini belirlemek için "Öğretmen Dijital Yeterlilik Ölçeği" ve dijital okuryazarlık düzeylerini belirlemek için "Dijital Okuryazarlık Ölçeği" kullanılarak toplanmıştır. Verilerin analizinde betimsel istatistikler ve parametrik testler kullanılmıştır.

Bulgular: Araştırma bulguları öğretmenlerin dijital yeterlilik ve dijital okuryazarlık düzeylerinin yüksek olduğunu ortaya koymuştur. Cinsiyet değişkenine göre dijital okuryazarlık açısından anlamlı bir fark bulunurken, dijital yeterlilik açısından anlamlı farklılık gözlenmemiştir. ANOVA sonuçları, öğretmenlerin görev yaptıkları eğitim seviyelerine göre dijital bilişsel ve teknik okuryazarlık alt boyutlarında ve genel dijital okuryazarlık düzeyi açısından anlamlı farklar olmadığını, ancak, lise öğretmenlerinin ilköğretim öğretmenlerine kıyasla daha yüksek dijital yeterlilik puanlarına sahip olduğunu ortaya koymuştur. Korelasyon analizi, dijital okuryazarlık ile dijital yeterlilik arasında güçlü ve pozitif bir ilişki olduğunu göstermiştir. Basit doğrusal regresyon analizi ise dijital okuryazarlığın dijital yeterliliği anlamlı şekilde öngördüğünü ve varyansının %45'ini açıkladığını göstermiştir.

Önemli Vurgular: Bu çalışmanın bir sonucu olarak, özellikle ilköğretim düzeyindeki öğretmenler için dijital yetkinlik ve okuryazarlığı artırmaya odaklanan hedefli mesleki gelişim programlarının uygulanması önerilmektedir. Bu programlar, özellikle dijital teknoloji ve dijital okuryazarlık becerilerinin daha düşük olduğu bölgelerde ve eğitim kademelerinde uygulanmalıdır. Cinsiyetler arası dijital okuryazarlık farkını azaltmak için ise öğretmenlere yönelik cinsiyete duyarlı dijital beceri geliştirme atölyeleri düzenlenmeli, bu farkın dijital eğitimde eşitsizliklere yol açmasının önüne geçilmelidir. Dijital okuryazarlığın dijital yeterliliği anlamlı şekilde öngördüğü bulgusu ışığında, dijital okuryazarlık eğitiminin tüm öğretmenler için zorunlu hale getirilmesi önem arz etmektedir.

¹ Corresponded Author, Selcuk University, School of Foreign Languages, Konya, TÜRKİYE; <https://orcid.org/0000-0002-4536-4049>

INTRODUCTION

The integration of technology into education has fundamentally altered teaching practices, requiring educators to develop new skills beyond traditional competencies (Herro et al., 2021; Tondeur et al., 2017). Modern education now demands proficiency in digital tools and the ability to integrate these tools effectively into classroom environments (Mishra & Koehler, 2006). The Technological Pedagogical Content Knowledge (TPACK) framework emphasizes the importance of teachers' ability to combine content knowledge, pedagogy, and technology to enhance student learning (Koehler & Mishra, 2008). Teachers are not only expected to master the subjects they teach but also to skillfully use digital technologies to engage students and improve instructional outcomes (Ocak & Karafil, 2021; Snyder, 2014).

Teachers' technological competence in the teaching-learning process spans a broad spectrum, encompassing traditional tools like pen and paper as well as modern digital resources such as the Internet, digital video, interactive whiteboards, and various software programs (Ventayen, 2019). It is crucial for educators not only to master the subjects they teach but also to achieve instructional objectives effectively through technological means. The integration of technology into teaching practices is influenced by several factors, including teachers' professional self-efficacy, age, educational background, and perceptions of technology. Studies have shown that teachers' pedagogical digital competence is significantly influenced by factors such as professional development, access to digital tools, and institutional support (Guillén-Gámez et al., 2021). Research indicates that instructors' adeptness with technology significantly impacts their ability to enhance learning, plan lessons, and facilitate classroom interactions (Foulger et al., 2017; Zhu et al., 2013). Therefore, understanding and leveraging technological tools are essential for educators to foster engaging and effective learning environments.

With its continuously evolving and active structure, the world of technology necessitates acquiring new communication skills and using media and technological tools responsibly and effectively to keep pace with its speed. In this context, recent advancements in digital technology have introduced the concept of digital literacy (Kurt et al., 2013). In today's increasingly digital educational environments, it is becoming imperative for teachers to have sufficient digital competence to integrate technology into their teaching practices. Teachers' digital competence encompasses a range of abilities enabling them to proficiently utilize diverse technologies to enhance the educational process (Chadegani et al., 2013). Central to achieving this competence is the concept of digital literacy, which encompasses the foundational skills necessary for educators to effectively implement technology in their teaching practices (Orakova et al., 2024; Zhang, 2023).

Digital literacy, as articulated by Hicks et al. (2019), denotes the proficiency in utilizing digital technologies to access, evaluate, and generate information. This competency encompasses a broad spectrum of abilities, encompassing the adept use of digital tools for communication, problem-solving, and critical thinking (Digital Literacy, 2023). Essentially, digital literacy extends beyond mere technical proficiency with digital devices; it entails the cognitive capacity to comprehend and critically analyze digital content, coupled with the creative aptitude to effectively produce and share digital information. Bawden (2008) further elaborates on digital literacy as encompassing the awareness, attitudes, and competencies necessary for individuals to employ digital technologies both effectively and responsibly. This comprehensive definition underscores the significance of possessing not only technical skills but also a conscientious approach towards the use of digital tools (Tokaç Kan, 2020b).

Fundamentally, digital literacy can be distilled into two essential components: information literacy and digital communication skills. Information literacy revolves around comprehending how information is stored, disseminated, and effectively grasping digital texts. On the other hand, digital communication involves the creation of coherent text and content using digital tools, along with engaging in interactions on digital platforms. Moreover, digital literacy entails not just the capability to utilize digital resources but also the adeptness in critically evaluating information sourced from diverse multimedia platforms (Karagözoğlu & Gezer, 2022; Lestari et al., 2020).

Digital literacy encompasses the comprehensive ability to effectively utilize information and communication technologies across various digital platforms, employing both cognitive and practical skills. The advent of digital technologies has vastly expanded communication possibilities, enabling individuals to actively engage with current environmental trends and remain informed (Bai et al., 2022). This multifaceted literacy entails skills such as locating, evaluating, analyzing, and synthesizing digital information, as well as communicating, collaborating, and creating content using digital tools. In today's society, which places a premium on information, digital literacy is no longer merely beneficial but essential for individuals to prosper and achieve success (Fraillon et al., 2019). Individuals lacking strong digital literacy skills may encounter challenges in independent learning. Digital literacy also encompasses students' abilities to access, manage, and utilize information via technological devices, effectively fostering independence in learning. Teachers leverage their proficiency in current information technology tools and experiences—such as email, Google Classroom, and Google Meet—to cultivate digital citizenship among students. They integrate these digital media and technology components into classroom activities to promote interactive and engaging learning environments (Tohara, 2021). Digital literacy skills empower individuals by providing access to a diverse array of information sources and perspectives. This exposure stimulates critical thinking by prompting individuals to evaluate and compare multiple sources, recognize biases, and identify trustworthy information (Bawden, 2008; Tokaç Kan, 2020c). Thus, digital literacy not only equips individuals with practical skills but also nurtures a mindset essential for navigating today's information-rich landscape effectively.

From an educational standpoint, digital literacy stands as a vital skill set for teachers in the 21st century, profoundly impacting their efficiency and capabilities (Falloon, 2020). By integrating digital literacy into their practice, teachers can streamline everyday

tasks like grading, attendance management, and lesson planning, thereby dedicating more time to actual teaching and learning activities (Tokaç Kan, 2020b). This efficiency boost is crucial in maximizing instructional time and effectiveness. Moreover, digital literacy empowers teachers to collaborate seamlessly with colleagues and students across different geographical locations and time zones. This ability not only fosters a sense of community among educators but also enhances opportunities for shared learning experiences and professional development (Indeed, 2022). Additionally, digital literacy facilitates quick and convenient access to a vast array of educational resources. Teachers can easily tap into online repositories containing educational videos, podcasts, e-books, and other multimedia materials. These resources enrich classroom instruction by offering diverse content that caters to various learning styles and instructional needs (Korisztek, 2022). Thus, digital literacy not only optimizes teaching practices but also expands educators' pedagogical toolkit, enabling them to deliver engaging and comprehensive educational experiences to their students.

The role of teachers in driving the digital transformation of education is indisputably crucial (Bridwell-Mitchell, 2015; Lockton & Fargason, 2019). As today's students are widely considered digital natives proficient in using digital tools, it becomes imperative for educators, akin to parents, to possess digital literacy themselves. Karabulut (2015) discusses the classifications of digital natives, immigrants, and hybrids, highlighting the impact of these categories on educational practices. This competence equips teachers to effectively educate and guide their students in navigating the digital landscape. Educators who aim to cultivate digital literacy among their students must first attain a certain level of digital literacy (Doğan & Birişçi, 2022). Being digitally literate in the 21st century entails understanding the profound impact of digital and social media on our lives, as well as developing strategies to mitigate potential negative effects and promoting critical thinking skills. It also requires educators to embrace an open-minded approach to integrating educational tools offered by the digital age (Voogt et al., 2013). Research increasingly demonstrates that digital learning is significantly enhanced when it is supported by a well-defined pedagogical framework for teachers (Tamim et al., 2014). This framework not only aids in effectively integrating digital tools into teaching practices but also ensures that technology enhances learning outcomes by aligning with educational objectives and fostering meaningful engagement. Thus, fostering digital literacy among educators is pivotal not only for their professional growth but also for empowering them to deliver effective digital education experiences that meet the needs of today's learners.

Digital literacy supports teachers' ongoing professional development and enhances educational quality. This proficiency not only instills confidence but also strengthens their ability to leverage technological tools effectively, thereby optimizing teaching methodologies (Hamakali & Josua, 2023; Pérez-Escoda et al., 2019). Digital literacy is pivotal in enabling educators to teach and learn effectively within digital environments (Kılınç, 2023). Research has shown that teachers' digital literacy levels are strongly associated with their tendencies toward lifelong learning, highlighting the importance of digital literacy in ongoing professional development (Gökbulut, 2021). As teachers' digital literacy levels increase, so does their competence in the field of education. Recent research underscores the significant impact of effectively utilizing teachers' digital literacy on enhancing the teaching and learning processes within schools (Doğan & Birişçi, 2022; Kuru, 2019). Teachers and students alike benefit from heightened digital literacy, enabling them to use digital technology proficiently and expansively, which positively influences remote education outcomes, thereby enhancing instructional effectiveness (Li & Yu, 2022; Rapanta et al., 2020). Consequently, it is imperative for teachers to possess digital literacy skills to provide students with diverse and enriching learning experiences through the effective utilization of digital resources and tools. Enhancing these skills not only strengthens teachers' capacity to deliver high-quality education but also bolsters their career progression and professional development, rendering them more competitive and adaptable in their roles.

Aligned with the belief that education equips individuals for lifelong success, it is essential to adopt an educational framework that not only prepares individuals to adapt to but also excel amidst the rapid transformations and advancements of our time (Tüzel & Tok, 2013). A cornerstone of this preparation is the systematic and gradual integration of digital literacy skills starting from the foundational levels of education. The concept of digital literacy has emerged as a pivotal element in contemporary educational discussions worldwide, reflecting societies' growing integration of new technologies into everyday life. Consequently, there is a compelling necessity to meticulously embed digital literacy within core curricula and educational frameworks, particularly within primary and secondary education (Altun, 2019). This deliberate incorporation ensures that learners not only gain proficiency in responsibly utilizing digital tools and media but also cultivate critical thinking and problem-solving abilities crucial for thriving in a digitally driven environment. Moreover, in Türkiye, as well as globally, the discourse on education is evolving to underscore the integration of emerging technologies and the development of digital literacy skills among educators and students alike (Karabacak & Sezgin, 2019). Essentially, fostering digital literacy from an early educational stage is not solely about acquiring technical skills; it also aims to instill a mindset of adaptability, critical inquiry, and ethical responsibility in the face of technological progress. Therefore, educational policies and practices must continually adapt to ensure that individuals are equipped with the essential competencies needed to succeed in an increasingly digital and interconnected global society (Butler et al., 2024; European Commission, 2021; Tokaç Kan, 2020a; Tokaç Kan, 2024).

Significance of the Study

While there is growing emphasis on enhancing teachers' digital competences and literacy levels, the majority of current research has concentrated primarily on these aspects (Astuti et al., 2021; Fidan & Yeleğen, 2022; Köksal & Canlı, 2024; Yılmaz-Ergül & Taşar, 2023) and their digital literacy levels (Çam & Kırıyıcı, 2017; Korkmaz & Akçay, 2024; Ocak et al., 2022; Saripudin et al., 2021; Yontar, 2019). When considered in the context of Türkiye, to the best knowledge of the researcher, no previous study has

specifically investigated how teachers' digital technology competencies relate to their levels of digital literacy. Therefore, aiming to fill this gap in the existing literature, the main objective of this study is to explore the correlation between teachers' digital technology competencies and their levels of digital literacy in Türkiye. The limited number of studies in the Turkish context in which these two variables are addressed together increases the originality of the study and its potential to fill the gap in the literature. This study is also significant as it addresses the growing need for educators to develop digital literacy and technological competencies. In the modern educational landscape, teachers who are proficient in digital technologies can enhance their teaching methodologies, foster critical thinking, and facilitate interactive learning experiences. By understanding the relationship between digital technology competencies and digital literacy levels, this research provides insights into how educators can be better equipped to meet the demands of contemporary education. By examining the relationship between teachers' digital competencies and digital literacy levels, this study is expected to make a significant contribution to better understand the theoretical link between these two concepts. In this context the purpose of this study is to examine the relationship between teachers' digital technology competencies and digital literacy levels. In addition, the study aims to investigate whether these variables differ significantly based on gender and the education level at which teachers work, and whether digital competence significantly predicts digital literacy. This study addresses the following sub-problems:

1. "What is the digital technology competency and digital literacy levels of the teachers?"
2. "Do the digital technology competency and digital literacy levels of the teachers differ significantly according to gender and education level variables?"
3. "What is the predictive role of digital technology competency on teachers' digital literacy levels?"

In light of the research questions presented, this study aims to contribute to the growing literature by investigating the relationship between teachers' digital technology competences and their digital literacy levels. Understanding this interaction may be important for improving teaching practices in digitally orientated educational environments. By examining how factors such as gender and educational level influence these competencies, this research aims to provide valuable insights for educators, policy makers and institutions seeking to improve digital literacy among teachers. In this way, the study offers a more comprehensive understanding of the relationship between digital skills and personal or institutional characteristics. In addition, it is thought that the findings obtained from the research can be a guide for restructuring teacher education programs with digital content and planning in-service trainings. Furthermore, the findings are expected to strengthen targeted professional development initiatives that promote both digital competence and literacy, thus contributing to ensuring that teachers are adequately equipped to meet the changing demands of modern education. In conclusion, this study contributes to the ongoing discourse on educational technology by emphasizing the importance of developing both digital literacy and competence in teachers to create more effective and engaging learning environments.

METHOD/MATERIALS

This study utilized a correlational research model to investigate the relationship between teachers' digital technology competency and their levels of digital literacy. Correlational studies are designed to discern and analyze the nature of relationships between two or more variables (Miles & Shevlin, 2000). There are two primary types of correlational research: predictive and exploratory (Mertens, 2014). This study adopted a predictive correlation research approach. Predictive correlation research aims to ascertain the degree to which the variability in dependent variables can be explained by the variables under investigation (Mertens, 2014). Accordingly, this study investigated how digital technology competency predicts teachers' digital literacy levels. Additionally, this study aims to investigate whether digital technology competencies and digital literacy levels differ significantly based on teachers' gender and the level of education at which they work. It also examines whether digital competence significantly predicts digital literacy.

Sample of the Study

The sample of the study included 354 teachers working in different provinces of Türkiye selected by convenient sampling. Convenient sampling offers advantages such as easy access, time efficiency, and cost-effectiveness (Cohen, Manion, & Morrison, 2018). The descriptive data of the teachers involved in the study are shown in Table 1.

Table 1: Descriptive Data of the Teachers Included in the Sample

Variables	N	%
Gender		
<i>Male</i>	105	29.6
<i>Female</i>	249	70.3
Year of Work Experience		
<i>1-5 years</i>	41	11.5
<i>6-10 years</i>	60	16.9
<i>11-15 years</i>	70	19.7
<i>16-20 years</i>	57	16.1
<i>21-25 years</i>	85	24
<i>26 years and above</i>	40	11.2

Education Level		
Graduate	259	73.2
Master's Degree	89	25.1
Doctoral Degree	6	1.7
Education Level Teacher Works		
Preschool	14	3.9
Primary School	72	20.3
Middle School	89	25.1
High School	179	50.5
Following Technological Developments		
Yes	256	72.3
Partially	88	24.9
No	7	2
Receiving Digital Literacy Training		
Yes	95	26.8
No	259	73.2
Total	354	100

As seen in Table 1, 29.6% of the teachers were male (105 individuals) and 70.3% were female (249 individuals). Regarding work experience, 11.5% had 1-5 years of experience (41 individuals), 16.9% had 6-10 years (60 individuals), 19.7% had 11-15 years (70 individuals), 16.1% had 16-20 years (57 individuals), 24% had 21-25 years (85 individuals), and 11.2% had over 26 years of experience (40 individuals). In terms of education level, 73.2% held a graduate degree (259 individuals), 25.1% had a master's degree (89 individuals), and 1.7% had a doctoral degree (6 individuals). The education levels at which these teachers worked varied, with 3.9% in preschool (14 individuals), 20.3% in primary school (72 individuals), 25.1% in middle school (89 individuals), and 50.5% in high school (179 individuals). When asked about following technological developments, 72.3% responded affirmatively (256 individuals), 24.9% responded partially (88 individuals), and 2% responded negatively (7 individuals). Regarding digital literacy training, 26.8% had received training (95 individuals), while 73.2% had not (259 individuals).

Data Collection Tools

In the study, the "Teachers' Digital Competence Scale" and "Digital Literacy Scale" were used.

Teachers' Digital Competence Scale

The "Teachers' Digital Competence Scale" developed by Ergül and Taşar (2023) was used to assess the digital competency levels of teachers within the research scope. This scale, employing a 5-point Likert-type format, consists of 19 items measuring a single factor. Responses range from "Never" (1) to "Always" (5). According to Ergül and Taşar (2023), the scale demonstrated high internal consistency with a Cronbach's Alpha coefficient of .94. In the current study, the internal consistency coefficient of the scale was calculated as .92. This indicates a high level of reliability for the scale, falling within the recommended range of .80 to 1.00 for Cronbach's Alpha reliability coefficients (Alpar, 2013).

Digital Literacy Scale

The "Digital Literacy Scale" developed by Paşalı (2023) was used to evaluate the digital literacy levels of teachers. This scale, using a five-point Likert-type format, comprises 12 items categorized into two factors. Responses range from "Strongly Disagree" (1) to "Totally Agree" (5). This scale consists of two sub-dimensions: "cognitive domain" and "technical domain". The cognitive domain covers individuals' ability to understand, analyze and evaluate information in the digital environment and to use digital content critically. This dimension measures the ability to think critically and make sense of digital information. The technical domain includes individuals' ability to use digital tools and technologies effectively. This dimension measures practical knowledge and skills in the use of digital technologies. Both dimensions aim to comprehensively assess teachers' digital literacy levels. The Cronbach's Alpha internal consistency coefficient value of the scale was calculated as .88 for the "cognitive domain" sub-dimension and as .83 for the "technical domain" (Paşalı, 2023). In the current study, the Cronbach's Alpha internal consistency coefficient value of the scale was calculated as .88 for the cognitive domain sub-dimension and as .79 for the technical domain sub-dimension. Additionally, it was obtained as .91 for the total mean score sub-dimension, which indicated a high level of reliability (Alpar, 2013).

Data Collection Process

The data collection period for this study spanned from May 16, 2024, to June 19, 2024. A scale form was created using Google Forms, and a corresponding link was generated and disseminated to teachers through various social media platforms. Teachers

who expressed interest in participating were invited to complete the form. The entire data collection process was conducted over the course of approximately one month.

Data Analysis

In this study, descriptive statistics such as arithmetic mean, standard deviation, minimum, and maximum were utilized to assess the levels of teachers' digital technology competency and digital literacy. The items on the scales were rated on a range of 1 to 5 points. To categorize the teachers' competency and literacy levels, a formula was applied based on the score interval: $\text{Score Interval} = (\text{Highest score} - \text{Lowest score}) / 5$ (Guvendi & Serin, 2019; Kaplanoğlu, 2014). For instance, with scores ranging from 1 to 5, the score interval was calculated as $(5-1) / 5 = 0.8$. Accordingly, the mean scores for digital technology competency and digital literacy were categorized into five levels as follows: scores ranging from 1 to 1.79 were classified as very low, 1.80 to 2.59 as low, 2.60 to 3.39 as moderate, 3.40 to 4.19 as high, and 4.20 to 5.00 as very high (Kozikoğlu & Özcanlı, 2020). This categorization method provided a structured approach to interpret and analyze the data effectively.

Before proceeding with data analysis to address the study's sub-problems, data distribution was examined. Skewness and kurtosis values were calculated to assess the shape of the distribution, and Shapiro-Wilk and Kolmogorov-Smirnov tests were conducted to test for normality. According to Tabachnick and Fidell (2013), data with skewness and kurtosis values falling within the range of -1.5 to +1.5 are considered approximately normally distributed. Additionally, if the significance level (p-value) in the Shapiro-Wilk and Kolmogorov-Smirnov tests exceeds .05, the data is typically considered to follow a normal distribution. In the study, both the skewness and kurtosis values were within the acceptable range, and the p-values from the Shapiro-Wilk and Kolmogorov-Smirnov tests were greater than .05. Therefore, based on these findings, it was determined that the data followed a normal distribution. As a result, parametric statistical tests were deemed appropriate for analyzing the data.

The independent sample t-test was employed to assess whether there were significant differences in teachers' digital technology competency and digital literacy levels based on gender. Additionally, one way ANOVA test was conducted to determine whether the digital technology competency and digital literacy levels of the teachers differ significantly according to education level they work variable. Furthermore, Pearson correlation analysis was conducted to explore the relationship between teachers' digital technology competency and their digital literacy levels. According to Çokluk, Şekercioğlu and Büyüköztürk (2012), the interpretation of the Pearson correlation coefficient suggests that values between .00 and .29 indicate a low correlation, .30 to .69 indicate a moderate correlation, and .70 to 1.00 indicate a high correlation. The analysis revealed a statistically significant relationship between teachers' digital technology competency and their digital literacy levels. Consequently, simple linear regression analysis was subsequently employed to determine to what extent teachers' digital technology competency could predict their digital literacy levels. This regression analysis aimed to quantify the predictive power of digital technology competency in relation to digital literacy levels among teachers.

FINDINGS

Table 2 provides the descriptive statistics results for the scales used in the study, offering a detailed overview of the participants' digital technology competency and digital literacy levels.

Table 2: Descriptive data of the scales

Variable	Sub-dimensions	n	Min	Max	$\bar{X}$	Ss	Level
Digital Competence		354	1.32	5.00	3.48	.68	High
	Cognitive Domain	354	1.57	5.00	3.68	.62	High
Digital Literacy	Technical Domain	354	1.00	5.00	3.74	.64	High
	Total Mean Score	354	1.33	5.00	3.70	.59	High

As can be seen in Table 2, the mean score for teachers' digital competence is 3.48 (SD = 0.68), indicating a generally high level of competency. Similarly, the total mean score for digital literacy is 3.70 (SD = 0.59), with both the cognitive and technical domains of digital literacy showing high mean values of 3.68 (SD = 0.62) and 3.74 (SD = 0.64), respectively. These findings suggest that teachers, on average, demonstrate high proficiency in both their digital technology competencies and literacy skills.

The findings from the analysis comparing the digital technology competency and digital literacy levels of teachers across gender are presented in Table 3.

Table 3: Digital technology competency and digital literacy levels of teachers by gender variable

Variable	Gender	N	$\bar{X}$	S	sd	t	p
Digital Competence	Male	104	4.57	.62	351	-1.602	.110
	Female	249	4.44	.70			
Digital Literacy	Male	104	3.91	.52	224.664	-4.502	.000
	Female	249	3.62	.61			

When Table 3 is examined, it is seen that the digital competence levels of male teachers ($\bar{X}=4.57$) are higher than those of female teachers ($\bar{X}=4.44$), although the difference is not statistically significant ($t=-1.602$, $p=.11$). On the other hand, the digital literacy levels of male teachers ($\bar{X}=3.91$) are significantly higher than those of female teachers ($\bar{X}=3.62$), with a statistically significant difference ($t=-4.502$, $p=0.00$). These findings suggest that there is no notable gender difference in digital competence, but there is a significant gender difference in digital literacy, with male teachers demonstrating higher levels compared to their female counterparts. The significant gender difference in digital literacy, contrasted with the non-significant difference in digital competence, highlights a nuanced distinction in the way male and female teachers engage with and utilize digital technologies.

Table 4 presents the results of the ANOVA analysis, which examines whether there are significant differences in teachers' digital technology competency and digital literacy levels across various educational levels (Pre-School, Primary School, Middle School, and High School).

Table 4: Descriptive and ANOVA results for digital literacy and competence levels by school level where teachers work

Scales and Dimensions	Education Level Teachers Work	<i>n</i>	$\bar{X}$	<i>SD</i>	<i>DF</i>	Mean Squares	<i>F</i>	<i>p</i>
Digital Cognitive Domain	Pre-School	14	3.79	.73	3	.428	1.081	.357
	Primary School	72	3.78	.62	350	.396		
	Middle School	89	3.65	.66	353			
	High School	179	3.64	.60				
	Total	354	3.68	.62				
Digital Technical Domain	Pre-School	14	3.91	.57	3	.302	.723	.539
	Primary School	72	3.80	.67	350	.418		
	Middle School	89	3.75	.69	353			
	High School	179	3.70	.61				
	Total	354	3.74	.64				
Digital Literacy Total Mean Score	Pre-School	14	3.84	.64	3	.344	.960	.412
	Primary School	72	3.79	.60	350	.358		
	Middle School	89	3.69	.64	353			
	High School	179	3.67	.56				
	Total	354	3.70	.59				
Digital Competence Total Mean Score	Pre-School	14	3.65	.73	3	1.951	4.245	.006
	Primary School	72	3.68	.64	350	.460		
	Middle School	89	3.52	.63	353			
	High School	179	3.36	.70				
	Total	354	3.48	.68				

Based on the provided ANOVA results in Table 4, no statistically significant differences were obtained in the digital cognitive domain, digital technical domain, and digital literacy total mean score sub-dimensions across education levels (Pre-School, Primary School, Middle School, High School) ($p > .05$). This suggests that teachers' digital literacy, both in cognitive and technical aspects, remains consistent regardless of the school level in which they work.

However, a statistically significant difference was observed in the Digital Competence Total Mean Score across different educational levels ($F = 4.245$, $p = .006$). This indicates that the level of digital competence varies significantly depending on the educational setting. According to the Tukey post hoc analysis, high school teachers demonstrated significantly higher digital competence scores compared to primary school teachers. This finding implies that high school teachers, possibly due to the increased demand for technology integration in secondary education, are more proficient in utilizing digital tools compared to their primary school counterparts.

The relationship between teachers' digital technology competency and digital literacy levels is shown in Table 5.

Table 5: Correlation analysis results

Digital Literacy	Digital Competence		
	Pearson Correlation	Sig. (2-tailed)	<i>n</i>
Total Mean Score	.675**	.000	354

** Correlation is significant at the 0.01 level (2-tailed); ** $p < 0.01$, * $p < 0.05$

The results presented in Table 5 indicate a statistically significant and strong positive relationship between teachers' digital literacy and digital competence levels, as demonstrated by a Pearson correlation coefficient of $r = .675$, with a significance value of $p < 0.01$. This suggests that as teachers' digital literacy increases, their digital competence also tends to rise in a proportional manner. The strength of this correlation implies that digital literacy plays a crucial role in enhancing teachers' overall digital competence. Moreover, the significance of the correlation at the 0.01 level highlights the robustness of this relationship,

reinforcing the idea that digital literacy is an essential factor in fostering digital competence among educators. Further insights into how digital literacy predicts teachers' digital competence are explored in Table 6.

Table 6: Simple linear regression analysis between variables

	<i>B</i>	<i>SHB</i>	β	<i>t</i>	<i>p</i>
Constant	1.072	.155	-	6.903	.000
1– Digital Competence	.588	.034	.675	17.171	.000

$n=354$, $R=.675$, $R^2=.456$, $p<.01$

The results from Table 6 demonstrate that digital literacy is a significant predictor of digital competence among teachers. The β coefficient of 0.675 suggests a strong positive relationship, indicating that an increase in digital literacy is associated with a corresponding increase in digital competence. The R^2 value of 0.456 implies that approximately 45.6% of the variance in teachers' digital competence can be explained by their digital literacy levels, highlighting the substantial influence of digital literacy on their digital competence. The *t*-value of 17.171 and the *p*-value of .000 further confirm that this relationship is statistically significant, underscoring the robustness of the predictive model. These findings suggest that initiatives aimed at improving teachers' digital literacy could play a key role in enhancing their digital competence, thus supporting more effective integration of digital technologies in educational practices.

DISCUSSION

In the study investigating the correlation between teachers' digital competence and their levels of digital literacy, initial assessments were conducted to gauge both aspects among educators. The results revealed that teachers exhibited high levels of both digital competence and digital literacy. This shows a strong ability to use digital technologies effectively. These findings align with prior research indicating that teacher candidates also display a significant level of media literacy (Karaman & Karataş, 2009), supporting the role of media literacy in fostering overall digital competence. The high level of digital competence found in this study may be due to several factors. First, the increased use of digital technologies in education has pushed teachers to improve their digital skills (Gillen & Barton, 2010). Second, the COVID-19 pandemic, which forced a rapid shift to online learning, likely boosted educators' digital competencies (Dhawan, 2020). Lastly, professional development programs focused on digital literacy have played a significant role in enhancing these skills (Ertmer & Ottenbreit-Leftwich, 2010).

Comparatively, the findings from this study align with and diverge from existing literature that underscores the criticality of digital literacy among educators. Gümüş and Kukul (2023) determined that teachers generally exhibited an intermediate level of digital competence. Similarly, Dias-Trindade and Moreira (2020) observed comparable results, highlighting lower proficiency in pedagogical competencies and student-related factors, but stronger capabilities in professional competences. In contrast, Napal Fraile et al. (2018) identified notably low levels of digital competence among pre-service teachers, particularly in areas such as content production and problem-solving. Further studies yield varied outcomes. Çebi and Reisoglu (2020) reported intermediate levels of digital competences in pre-service teachers, with specific weaknesses noted in content development, digital media use, and technical problem-solving, yet strengths observed in information literacy, communication, cooperation, and security. Esteve Mon et al. (2020) found that pre-service teachers rated their competences highly in multimedia, communication, and collaboration skills. Conversely, Rokenes and Krumsik (2016) identified significant deficiencies in content development skills among pre-service teachers. Overall, these findings suggest a spectrum of digital skills among teachers, ranging from low to intermediate levels. Factors contributing to these variations may include the adequacy of in-service training programs, as noted by Çebi and Reisoglu (2020) and Ceylan and Gundogdu (2017).

In a study conducted by Aksoy et al. (2021), aimed at assessing the digital literacy levels of primary school teachers, it was revealed that these teachers demonstrated high levels of digital literacy. Similarly, a study conducted by Bingöl (2022) during the distance education period also found that teachers maintained elevated levels of digital literacy. These findings collectively suggest that teachers exhibit proficiency not only in comprehending digital content but also in utilizing diverse digital tools and platforms effectively. Such competence is pivotal in ensuring effective teaching practices in the contemporary digital era.

The digital competence among teachers does not show significant differences based on gender, indicating that both male and female teachers feel relatively confident and capable in their use of digital tools and technologies. The absence of significant differences in digital competence based on gender indicates that both male and female teachers feel relatively confident and capable in using digital tools and technologies. This parity may reflect the widespread integration of technology in educational settings, which requires all teachers to develop a certain level of proficiency regardless of gender. Gümüş and Kukul (2023) found that while there were no significant differences in digital competences between male and female teachers, male teachers tended to score slightly higher on average. Similarly, Kayhan (2022) discovered that male teachers used educational technology more frequently compared to their female counterparts. Studies have shown that male pre-service teachers generally possess higher levels of digital competence compared to their female counterparts (Guillén-Gámez et al., 2021). On the other hand, Çebi and Reisoglu (2020) identified significant differences favoring male pre-service teachers in areas such as information and data literacy, digital content production, security, and problem-solving skills. Keskin and Yazar (2015) also observed that male teachers exhibited greater competencies in computer use, digital media utilization, and data acquisition. Esteve-Mon et al. (2020) further noted that male teachers showed higher competence levels in technical problem-solving and programming skills. Additionally, studies by Guillén-Gámez et al. (2021) revealed that male pre-service teachers generally possessed higher levels of digital competence compared to their female counterparts. These mixed findings suggest that gender differences in digital competence may vary

depending on the context and environment. Factors such as access to technology, the nature of professional development opportunities, and the specific educational settings might influence these results. Therefore, the observed variations in digital competence by gender could be attributed to different contextual factors rather than a universal trend.

The significant difference in digital literacy scores between male and female teachers highlights a notable area of concern. The higher scores observed among male teachers suggest that they may possess greater proficiency in tasks related to understanding, evaluating, and applying digital information. This difference could stem from varying factors such as prior training, exposure to digital technologies, or differing levels of confidence in utilizing these tools. Korkmaz and Akçay (2024) concluded that younger and male teachers generally exhibit higher levels of digital literacy. Çam and Kırııcı (2017) explored digital literacy among prospective teachers by gender, finding that male prospective teachers tend to demonstrate higher levels of visual and computer literacy compared to their female counterparts. Previous research indicates that many teachers often lack sufficient digital literacy skills (Sun et al., 2016). However, recent evidence suggests improvement in educators' proficiency, particularly in data literacy (Kippers et al., 2018). Specifically, studies consistently show that male teachers typically display higher levels of digital literacy and technological competencies compared to females. Lin et al. (2013) found that male pre-service teachers generally exhibit stronger technological competencies than their female counterparts, a finding supported by other research highlighting persistent gender differences in technology usage and related skills (Colley & Comber, 2003; Drabowicz, 2014). According to Van Grootel et al. (2018) and colleagues, these disparities in technology adoption between genders may be attributed to societal gender stereotypes that traditionally associate males with autonomy and technology-related fields, while females are often linked with nurturing and pedagogical domains. Moreover, research indicates that males may perceive themselves as more capable and comfortable with computers, potentially providing them with an advantage in online educational settings (Ashong & Commander, 2012). In summary, the analysis highlights significant differences in digital literacy based on gender and access to technology. Male prospective teachers, as well as those with continuous computer and internet access, generally show higher levels of various facets of digital literacy. These findings underscore the importance of ensuring equal access to digital resources and opportunities for both male and female prospective teachers to bridge the digital literacy gap and enhance overall proficiency in the digital domain.

Findings revealed that teachers teaching at the high school level demonstrated significantly higher levels of digital competence compared to those teaching at the primary school level. This suggests that educators in high school settings generally possess greater digital competence, encompassing a broader range of digital skills and abilities, than their counterparts in primary school settings. This finding is crucial as it highlights disparities in digital competence across educational stages, underscoring the potential need for targeted professional development initiatives and support systems aimed at enhancing digital skills among teachers, particularly those in primary school settings. Strengthening digital competence across all educational levels is essential for equipping teachers with the necessary skills to effectively integrate technology into teaching practices and enhance educational outcomes in today's digital age. Gümüş and Kukul (2023) found that the digital competences of the teachers working in high schools were lower than those of secondary school teachers. Arslan (2019) asserts that elementary and middle school teachers have a high level of digital literacy. Ayaz (2016) suggests that this difference in lifelong learning inclinations might explain why high school teachers are less engaged in developing digital competencies. Their diminished enthusiasm for continuous learning likely affects their willingness to explore and integrate new digital tools and technologies in their teaching practices. This contrast with middle school teachers, who generally exhibit higher lifelong learning tendencies and thus display more curiosity and motivation to enhance their digital skills.

The correlation analysis revealed a strong and statistically significant positive relationship between teachers' digital literacy and digital competence. This indicates that as teachers' proficiency in digital literacy increases, their competence in utilizing digital technologies also tends to increase, and vice versa. The correlation coefficient suggests a strong relationship between these two variables, underscoring the importance of digital literacy as a foundational skill that supports enhanced digital competence among educators. Similarly, Pehlevan and Ünal (2024) found a strong correlation between digital literacy and technological, pedagogical and content knowledge (TPACK) levels of pre-service teachers. Moreover, a noteworthy positive correlation was found between the Technical dimension of digital literacy and TPACK. Altun (2017) also identified a significantly strong relationship between TPACK and digital literacy. The findings of simple linear regression analysis further confirm the predictive role of digital literacy in determining teachers' digital competence levels. Orakova et al. (2024) found that teachers' digital literacy significantly predicted their pedagogical and technological competencies. These findings underscore the critical importance of fostering digital literacy skills among teachers as a means to enhance their digital competence. Initiatives aimed at improving digital literacy can potentially lead to more effective integration of technology in educational practices, ultimately benefiting student learning outcomes in today's increasingly digital-centric educational environment.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study, it is evident that teachers exhibit high levels of both digital competence and digital literacy. Gender variable does not significantly influence teachers' digital competence levels, indicating similar proficiency between male and female teachers in utilizing digital tools and technologies. However, male teachers tend to exhibit higher average scores in specific digital competencies. Moreover, the study reveals disparities in digital competence across educational levels teachers

work, with high school teachers demonstrating significantly higher digital competence compared to primary school teachers. The predictive role of digital literacy in determining digital competence levels highlights the critical importance of integrating comprehensive digital literacy training into educational practices. The findings emphasize the critical importance of integrating digital literacy training into professional development programs to empower teachers in navigating and leveraging digital tools in educational settings. In conclusion, fostering digital literacy skills among teachers through targeted professional development initiatives is essential for effective integration of technology into teaching practices. Addressing gender disparities in digital competencies and ensuring equitable access to digital resources are pivotal steps towards enhancing overall educational outcomes in today's digital-centric environment. By improving these skills, teachers will be better equipped to integrate technology effectively in educational settings, ultimately improving student outcomes.

FUTURE IMPLICATIONS

Future studies could benefit from larger and more diverse samples to generalize findings across different regions or educational settings. This would enhance the robustness and applicability of the results. While this study focused on variables such as gender, education level teacher work, future research could investigate other factors such as subject specialization, socio-economic background, or specific digital tools used by teachers. The study's findings suggest variability in digital competence across different educational settings. Future research could focus on specific educational levels (e.g., primary vs. secondary) or regional differences to identify targeted needs and tailor professional development programs accordingly. More research is needed on the impact of specific digital tools and technologies used by teachers. This could help in understanding how different tools influence digital competence and guide the selection and integration of these tools in educational settings. Supplementing quantitative findings with qualitative research, such as interviews and case studies, could offer deeper insights into teachers' experiences, challenges, and perspectives on digital literacy and competence. Findings from this study can inform policy decisions related to teacher training programs and curriculum development, ensuring they align with the evolving demands of digital education.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author received no financial support for the research, author-ship, and/or publication of this article.

Statements of publication ethics

I hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Ethics Committee Approval Information

In the study, volunteering was taken as a basis, and all individuals who participated were required to read and sign a consent form prior to taking part. Participants were fully informed about the research's aim and the confidentiality of any information they provided. Moreover, the researchers obtained scale permission for the use of scales. Ethical approval for this study was obtained from the Scientific Research Ethics Committee of Selcuk University, School of Foreign Languages, with the decision number 2024/04, dated 07 May 2024.

REFERENCES

- Altun, N. (2019). *Temel eğitim programları ve ders kitaplarının dijital okuryazarlık bağlamında incelenmesi* [Unpublished master's thesis]. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.
- Arslan, E. (2019). *Ortaokul öğretmenlerinin ve öğrencilerinin eğitim bilişim ağı (EBA) platformu hakkındaki görüşleri: Hatay ili örneği* [Master's thesis]. Çukurova Üniversitesi Sosyal Bilimler Enstitüsü, Adana.
- Ashong, C. Y., & Commander, N. E. (2012). Ethnicity, gender, and perceptions of online learning in higher education. *MERLOT Journal of Online Learning and Teaching*, 8(2). Retrieved from https://jolt.merlot.org/vol8no2/ashong_0612.htm
- Astuti, M., Arifin, Z., Mutohhar, F., & Nurtanto, M. (2021). Competency of digital technology: the maturity levels of teachers and students in vocational education in Indonesia. *Journal of Education Technology*, 5(2), 254-262. <https://doi.org/10.23887/jet.v5i3.35108>
- Bai, J., Zhang, H., Chen, Q., Cheng, X., & Zhou, Y. (2022). Technical supports and emotional design in digital picture books for children: a review. *Procedia Computer Science*, 201, 174-180. <https://doi.org/10.1016/j.procs.2022.03.025>
- Bawden, D. (2008). Origins and concepts of digital literacy. In C. Lankshear & M. Knobel (Eds.), *Digital literacies: Concepts, policies and practices* (pp. 17-32). Peter Lang Publishing: UK.
- Bingöl, H. (2022). *Uzaktan eğitim sürecinde öğretmenlerin dijital okuryazarlık düzeyleri ile mesleki motivasyonlarının incelenmesi* [Master's Thesis]. Zonguldak Bülent Ecevit Üniversitesi, Sosyal Bilimler Enstitüsü, Zonguldak.
- Bridwell-Mitchell, E. N. (2015). Theorizing teacher agency and reform: How institutionalized instructional practices change and persist. *Sociology of Education*, 88(2), 140-159. <https://doi.org/10.1177/0038040715575559>

- Butler, D., Leahy, M., Charania, A., Gedara, P. M., Keane, T., Laferrière, T., Nakamura, K., Ueda, H., Bocconi, S., & ... (2024). Aligning digital educational policies with the new realities of schooling. *Technology, Knowledge and Learning*, 29, 1831–1849. <https://doi.org/10.1007/s10758-024-09776-9>
- Ceylan, V. & Gündoğdu, K. (2017). E-content development skills of teachers: an in-service training experience. *Journal of Education and Humanities: Theory and Practice*, 8(15), 48-74
- Chadegani, A. A., Salehi, H., Yunus, M. M., Farhadi, H., Fooladi, M., Farhadi, M., & Ebrahim, N. A. (2013). A comparison between two main academic literature collections: Web of Science and Scopus databases. *Asian Soc Sci*, 9(18), 1-26. <https://doi.org/10.48550/arXiv.1305.0377>
- Cohen, L., Manion, L., & Morrison, K. (2018). *Research methods in education* (8th ed.). Routledge.
- Colley, A., & Comber, C. (2003). Age and gender differences in computer use and attitudes among secondary school students: what has changed?. *Educational research*, 45(2), 155-165. <https://doi.org/10.1080/0013188032000103235>
- Çam, E., & Kırıyıcı, M. (2017). Perceptions of prospective teachers on digital literacy. *Malaysian Online Journal of Educational Technology*, (4), 29-44. Retrieved from https://drive.google.com/file/d/1UubzdfQ6xK7sZ6x_6au00dmDajf7POOQ/view
- Çebi, A., & Reisoğlu, İ. (2020). Digital competence: A study from the perspective of pre-service teachers in Turkey. *Journal of New Approaches in Educational Research (NAER Journal)*, 9(2), 294-308. Retrieved from <https://www.learntechlib.org/p/217619/>.
- Çokluk, Ö., Şekercioğlu, G., & Büyüköztürk, Ş. (2012). *Sosyal bilimler için çok değişkenli istatistik: SPSS ve LISREL uygulamaları (2. basım)/ Multivariate statistics for social sciences: SPSS and LISREL applications (2nd ed.)*. Pegem Akademi.
- Dhawan, S. (2020). Online Learning: A Panacea in the Time of COVID-19 Crisis. *Journal of Educational Technology Systems*, 49(1), 5-22. <https://doi.org/10.1177/0047239520934018>
- Dias-Trindade, S. & Moreira, J. A. (2020). Assessment of high school teachers on their digital competences. *MAGIS, Revista Internacional de Investigación en Educación*, 13(1), 1-21
- Digital Literacy. (2023, September 12). Retrieved from <https://uis.unesco.org/en/glossary-term/digital-literacy>
- Doğan, C., & Birişçi, S. (2022). Covid-19 süreciyle birlikte öğretmenlerin dijital okuryazarlık düzeylerinin incelenmesi. *Ege Eğitim Teknolojileri Dergisi*, 6(1), 53-76. Retrieved from <https://dergipark.org.tr/en/pub/eetd/issue/70271/1152403>
- Drabowicz, T. (2014). Gender and digital usage inequality among adolescents: A comparative study of 39 countries. *Computers & Education*, 74, 98-111. <https://doi.org/10.1016/j.compedu.2014.01.016>
- Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education*, 42(3), 255-284. <https://doi.org/10.1080/15391523.2010.10782551>
- Esteve-Mon, F., Llopis, M. & Adell-Segura, J. (2020). Digital competence and computational thinking of student teachers. *International Journal of Emerging Technologies in Learning (IJET)*, 15(2), 29-41. Retrieved from <https://www.learntechlib.org/p/217159/>.
- European Commission. (2021). *Digital education initiatives: Digital education action plan (2021–2027)*. In European Education Area. Retrieved from <https://education.ec.europa.eu/eu/focus-topics/digital-education/about-digital-education>
- Falloon, G. (2020). From digital literacy to digital competence: the teacher digital competency (TDC) framework. *Educational technology research and development*, 68(5), 2449-2472. <https://doi.org/10.1007/s11423-020-09767-4>
- Guillén-Gámez, F. D., Mayorga-Fernández, M. J., Bravo-Agapito, J., & Escribano-Ortiz, D. (2021). Analysis of teachers' pedagogical digital competence: Identification of factors predicting their acquisition. *Technology, Knowledge and Learning*, 26(3), 481-498. <https://doi.org/10.1007/s10758-019-09432-7>
- Fidan, M., & Yeleğen, H. C. (2022). Öğretmenlerin dijital yeterliklerinin çeşitli değişkenler açısından incelenmesi ve dijital yeterlik gereksinimleri. *Ege Eğitim Dergisi*, 23(2), 150-170. <https://doi.org/10.12984/egedf.1075367>
- Foulger, T. S., Graziano, K. J., Schmidt-Crawford, D., & Slykhuis, D. A. (2017). Teacher educator technology competencies. *Journal Of Technology And Teacher Education*, 25(4), 413-448. Retrieved July 13, 2024 from <https://www.learntechlib.org/primary/p/181966/>.
- Fraillon, J., Ainley, J., Schulz, W., Friedman, T., & Duckworth, D. (2019). *Preparing for life in a digital world: IEA international computer and information literacy study 2018 international report*. Amsterdam: International Association for the Evaluation of Educational Achievement (IEA). <https://www.iea.nl/publications/study-reports/preparing-life-digital-world>
- Gillen, J., & Barton, D. (2010). *Digital literacies: A research briefing by the Technology Enhanced Learning Phase of the Teaching and Learning Research Programme (TLRP)*. JISC. <http://www.tlrp.org/docs/DigitalLiteracies.pdf>
- Gökbulut, B. (2021). Öğretmenlerin dijital okuryazarlık düzeyleri ile hayat boyu öğrenme eğilimlerinin incelenmesi. *Yükseköğretim ve Bilim Dergisi*, 11(3), 469- 479. <https://doi.org/10.5961/higheredusci.896998>.
- Gümüş, M. M., & Kukul, V. (2023). Examination of digital competences of teachers according to different variables. *Journal of Teacher Education and Lifelong Learning*, 5(1), 111-129. <https://doi.org/10.51535/tell.1231192>
- Hamakali, H. P. S., & Josua, L. M. (2023). Engendering technology-assisted pedagogy for effective instructional strategy in the University of Namibia language centre. *Research in Educational Policy and Management*, 5(1), 18-32. <https://doi.org/10.46303/repam.2023.3>
- Herro, D., Visser, R., & Qian, M. (2021). Teacher educators' perspectives and practices towards the Technology Education Technology Competencies (TETCs). *Technology, Pedagogy and Education*, 30(5), 623-641. <https://doi.org/10.1080/1475939X.2021.1970620>.
- Hicks, T. W., Baleja, K., & Zhang, M. (2019). Digital literacy. *Oxford Bibliographies*. <https://doi.org/10.1093/obo/9780199756841-0239>
- Indeed. (2022). 5 reasons digital literacy is important for educators. *Indeed*. Retrieved July 1, 2024, from <https://www.indeed.com/career-advice/career-development/digital-literacy>
- Karabacak, Z. İ. & Sezgin, A. A. (2019). Türkiye’de Dijital dönüşüm ve dijital okuryazarlık. *Türk İdare Dergisi*, 91(488), 319-343.

- Karabulut, B. (2015). Bilgi toplumu çağında dijital yerliler, göçmenler ve melezler. *Pamukkale Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 21, 11-23. Retrieved from <https://dergipark.org.tr/en/pub/pausbed/issue/34743/384200>
- Karagözoğlu, N., & Gezer, U. (2022). An investigation of the relationship between digital literacy levels of social studies teacher candidates and their attitudes towards distance education. *Educational Policy Analysis and Strategic Research*, 17(1), 218-235. Retrieved from <https://eric.ed.gov/?id=EJ1334602>
- Karaman, M. K. & Karataş, A. (2009). Öğretmen adaylarının medya okuryazarlık düzeyleri. *İlköğretim Online*, 8(3), 798-808. Retrieved from <https://dergipark.org.tr/en/pub/ilkonline/issue/8597/106997>
- Kayhan, O. (2022). Understanding teachers' classroom management anxiety: the role of educational technology usage in classrooms. *Journal of Teacher Education and Lifelong Learning*, 4(2), 51-64. <https://doi.org/10.51535/tell.1148725>
- Kılınç, S. (2023). Embracing the future of distance science education: Opportunities and challenges of ChatGPT integration. *Asian Journal of Distance Education*, 18(1), 205- 237. <https://doi.org/10.5281/zenodo.7857396>.
- Kippers, W. B., Poortman, C. L., Schildkamp, K., & Visscher, A. J. (2018). Data literacy: What do educators learn and struggle with during a data use intervention?. *Studies in Educational Evaluation*, 56, 21-31. <https://doi.org/10.1016/j.stueduc.2017.11.001>
- Koehler, M. J., & Mishra, P. (2008). Introducing TPCK. AACTE Committee on Innovation and Technology (Ed.), *The handbook of technological pedagogical content knowledge (TPCK) for educators* (pp. 3-29). Mahwah, NJ: Lawrence Erlbaum Associates.
- Korisztek, R. (2022). Teachers' digital literacy when teaching online. *World of Better Learning*. Cambridge University Press. Retrieved September 12, 2023, from <https://www.cambridge.org/elt/blog/2021/07/13/teachers-digital-literacy-teaching-online/>
- Korkmaz, M., & Akçay, A. O. (2024). Determining digital literacy levels of primary school teachers. *Journal of Learning and Teaching in Digital Age*, 9(1), 1-16. <https://doi.org/10.53850/joltida.1175453>
- Köksal, D. & Canlı, S. (2024). Öğretmenlerin dijital yeterliliklerinin incelenmesi [Examination of Teachers' Digital Competencies]. *Bilim, Eğitim, Sanat ve Teknoloji Dergisi (BEST Dergi) [Science, Education, Art and Technology Journal (SEAT Journal)]*, 8(1), 1-21.
- Kuru, E. (2019). Sosyal bilgiler öğretmen adaylarının dijital okuryazarlık kavramına ilişkin görüşleri. *Turkish Studies*, 14(3), 1629-1648.
- Kurt, A. A., Dönmez, F. İ., Ersoy, M., Dindar, M., Mısırlı, Ö. & Akçay, T. (2013). Teknoloji ışığında okuryazarlıklar. *Eğitim Teknolojileri Araştırmaları Dergisi*, 4(2), 1-24.
- Lestari, H., Siskandar, R., & Rahmawati, I. (2020). Digital literacy skills of teachers in elementary school in the revolution 4.0. *International Conference on Elementary Education*, 2(1), 302-311. Retrieved from <http://proceedings2.upi.edu/index.php/icee/article/view/631>
- Li, M., & Yu, Z. (2022). Teachers' satisfaction, role, and digital literacy during the covid-19 pandemic. *Sustainability*, 14, 1121, 1-19. <https://doi.org/10.3390/su14031121>
- Lin, T. C., Tsai, C. C., Chai, C. S., & Lee, M. H. (2013). Identifying science teachers' perceptions of technological pedagogical and content knowledge (TPACK). *Journal of Science Education and Technology*, 22, 325-336. <https://doi.org/10.1007/s10956-012-9396-6>
- Lockton, M., & Fargason, S. (2019). Disrupting the status quo: How teachers grapple with reforms that compete with long-standing educational views. *Journal of Educational Change*, 20(4), 469-494. <https://doi.org/10.1007/s10833-019-09351-5>
- Mertens, D. M. (2014). Ethical use of qualitative data and findings. In U. Flick (Ed.), *The Sage handbook of qualitative data analysis* (pp. 510–523). Sage.
- Millî Eğitim Bakanlığı (MEB). (2020). *Dijital okuryazarlık öğretmen kılavuzu*. Ankara.
- Miles, J., & Shevlin, M. (2000). *Applying regression and correlation: A guide for students and researchers*. Sage Publications.
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017-1054. <https://doi.org/10.1111/j.1467-9620.2006.00684.x>
- Napal Fraile, M., Penalva-Velez, A. & MendiorozLacambra, A. M. (2018). Development of digital competence in secondary education teachers' training. *Education Sciences*, 8(3), 104. <https://doi.org/10.3390/educsci8030104>
- Ocak, G., Çengelci, S., & Yurtseven, R. (2022). Öğretmenlerin dijital okuryazarlık beceri düzeyleri ile yaşam boyu öğrenme eğilimleri arasındaki ilişkinin incelenmesi (Afyonkarahisar Örneği). *Uluslararası Sosyal Bilimler Eğitimi Dergisi*, 8(1), 123-155. <https://doi.org/10.47615/issej.1103143>
- Ocak, G. & Karafil, B. (2021). Teachers' perceptions of their technological competence in learning and teaching process. *Malaysian Online Journal of Educational Technology*, 9(4), 14-30. <http://dx.doi.org/10.52380/mojet.2021.9.4.221>
- Orakova, A., Nametkulova, F., Issayeva, G., Mukhambetzhanova, S., Galimzhanova, M., & Rezuanova, G. (2024). The relationships between pedagogical and technological competence and digital literacy level of teachers. *Journal of Curriculum Studies Research*, 6(1), 1-21. <https://doi.org/10.46303/jcsr.2024.2>
- Pehlevan, İ., & Ünal, B. Investigating the relationship between digital literacy and TPACK levels of pre-service english teachers. *Journal of Language Education and Research*, 10(1), 87-111. <https://doi.org/10.31464/jlere.1432879>
- Pérez-Escoda, A., García-Ruiz, R., & Aguaded, I. (2019). Dimensions of digital literacy based on five models of development / Dimensiones de la alfabetización digital a partir de cinco modelos de desarrollo. *Culture and Education*, 31(2), 232-266. <https://doi.org/10.1080/11356405.2019.1603274>
- Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., & Koole, M. (2020). Online university teaching during and after the Covid-19 crisis: Refocusing teacher presence and learning activity. *Postdigital Science and Education*, 2, 923–945. <https://doi.org/10.1007/s42438-020-00155-y>
- Rokenes, F. M. & Krumsvik, R. J. (2016). Prepared to teach ESL with ICT? A study of digital competence in Norwegian teacher education. *Computers & Education*, 97, 1-20. <https://doi.org/10.1016/j.compedu.2016.02.014>

- Saripudin, S., Budiyanoto, I. B., Listiana, R. E. N. I., & Ana, A. (2021). Digital literacy skills of vocational school teachers. *Journal of Engineering Science and Technology*, 16(1), 666-680. Retrieved from https://jestec.taylors.edu.my/Vol%2016%20issue%201%20February%202021/16_1_46.pdf
- Snyder, M. (2014). *Technology integration for educators: The why and the how* [Master's Thesis]. Eastern Michigan University.
- Sun, J., Przybylski, R., & Johnson, B. J. (2016). A review of research on teachers' use of student data: From the perspective of school leadership. *Educational Assessment, Evaluation and Accountability*, 28, 5-33. <https://doi.org/10.1007/s11092-016-9238-9>
- Tamim, R. M., Borokhovski, E., Bernard, R. M., Schmid, R. F., Abrami, P. C., & Sokolovskaya, A. (2014). *Technology use in teacher training programs: Lessons learned from a systematic review*. Paper presented at the AERA 2014 annual meeting in Philadelphia, PA.
- Tezci, E. (2011). Factors that influence pre-service teachers' ICT usage in education. *European Journal of Teacher Education*, 34(4), 483-499. <https://doi.org/10.1080/02619768.2011.587116>
- Tohara, A. J. T. (2021). "Exploring digital literacy strategies for students with special educational needs in the digital age". *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, 12(9), 3345-3358. <https://doi.org/10.17762/turcomat.v12i9.5741>
- Tokaç Kan, A. (2024). Exploring the impact of SCOPA creation on language learners' reading and reflective thinking skills in a concept-based reading curriculum. *International Journal of Contemporary Educational Research*, 11(1), 64-85.
- Tokaç Kan, A. (2020a). *Designing a concept-based reading curriculum for language learners*. Çizgi Yayınevi.
- Tokaç Kan, A. (2020b). *Computer-assisted vocabulary instruction*. Çizgi Yayınevi.
- Tokaç Kan, A. (2020c). Reading material evaluation in EAP: An example of a dialogic approach. In T. Akşit (Ed.), *The future of teaching English for academic purposes: Standards, provision, and practices* (pp. 121-132). Cambridge Scholars Publishing.
- Tondeur, J., Pareja Roblin, N., van Braak, J., Voogt, J., & Prestridge, S. (2017). Preparing beginning teachers for technology integration in education: Ready for take-off?. *Technology, Pedagogy and Education*, 26(2), 157-177. <https://doi.org/10.1080/1475939X.2016.1193556>
- Tüzel, S. & Tok, M. (2013). Öğretmen adaylarının dijital yazma deneyimlerinin incelenmesi. *Tarih Okulu Dergisi*, 6(15), 577-596. <https://doi.org/10.14225/Joh292>
- Van Grootel, S., Van Laar, C., Meeussen, L., Schmader, T., & Sczesny, S. (2018). Uncovering pluralistic ignorance to change men's communal self-descriptions, attitudes, and behavioral intentions. *Frontiers in psychology*, 9, 1344. <https://doi.org/10.3389/fpsyg.2018.01344>
- Ventayen, R. J. M. (2019). Educator's competencies on the application of technological tools in teaching. *International Journal of Scientific & Technology Research*, 8(11). Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3491717
- Voogt, J., Erstad, O., Dede, C., & Mishra, P. (2013). Challenges to learning and schooling in the digital networked world of the 21st century. *Journal of Computer Assisted Learning*, 29(5), 403-413. <https://doi.org/10.1111/jcal.12029>
- Wang, Q., & Woo, H. L. (2007). Systematic planning for ICT integration in topic learning. *Journal of Educational Technology & Society*, 10(1), 148-156. Retrieved from <https://www.jstor.org/stable/10.2307/jeductechsoci.10.1.148>
- Yılmaz-Ergül, D., & Taşar, M. F. (2023). Development and validation of the teachers' Digital Competence Scale (TDiCoS). *Journal of Learning and Teaching in Digital Age*, 8(1), 148-160. <https://doi.org/10.53850/joltida.1204358>
- Yontar, A. (2019). Öğretmen adaylarının dijital okuryazarlık düzeyleri. *Ana Dili Eğitimi Dergisi*, 7(4), 815-824. <https://doi.org/10.16916/aded.593579>
- Zhang J. (2023). EFL teachers' digital literacy: the role of contextual factors in their literacy development. *Frontiers in psychology*, 14, 1153339. <https://doi.org/10.3389/fpsyg.2023.1153339>
- Zhu, C., Wang, D., Cai, Y., & Engels, N. (2013). What core competencies are related to teachers' innovative teaching? *Asia-Pacific Journal of Teacher Education*, 41(1), 9-27. <https://doi.org/10.1080/1359866X.2012.753984>.