ULUSLARARASI EĞİTİM ARAŞTIRMACILARI DERGİSİ (UEADER)

INTERNATIONAL JOURNAL OF SCHOLARS IN EDUCATION (IJSE)

ISSN: 2667-4998

CİLT/ VOLUME: 7 SAYI / ISSUE: 2 TARİH / YEAR: ARALIK (DECEMBER) 2024

CİLT / VOLUME: 7 ***SAYI / ISSUE***: 2

ARALIK 2024 / DECEMBER 2024

Uluslararası Eğitim Araştırmaları Dergisi (UEADER) ücretsiz yayım yapan hakemli bir dergidir.

Dergide yayımlanan makalelerin fikri ve mülki sorumluluğu yazarlara aittir.

International Journal of Scholars in Education is a peer-reviewed free journal.

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INTERNATIONAL JOURNAL OF SCHOLARS IN EDUCATION (IJSE)

ISSN: 2667-4998

Baş Editör/Chief Editor: Dr. Durmuş BURAK

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Dizinler / **Indexes**: CROSSREF, IndexCopernicus, TEİ: Index of Turkish Education, Asos Index, DRJI (Directory of Research Journal Indexing), ERIH PLUS, BASE (Bielefel Academic Search Engine), Google Scholar, ROAD, ESJI (Eurasian Scientific Journal Index), WorldCat, OpenAIRE, MIAR, Scilit

2024 KİLİS, TURKEY

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DERLEME MAKALELER/ REVIEW ARTICLES

Research Article
Received: 07.06.2024
Accepted: 23.12.2024
Published: 31.12.2024

Citation: Corcuera, L. C., (2024). Uncovering QuillBot: Filipino senior high school students' experiences and factors influencing its use in enhancing language writing skills. *International Journal of Scholars in Education*, *7*(2), 67-81. https://doi.org/10.52134/ueader.1497368

Uncovering QuillBot: Filipino Senior High School Students' Experiences and Factors Influencing Its Use in Enhancing Language Writing Skills*

Lovely C. CORCUERA**

Abstract: English is the second language in the Philippines and is imperative in the contemporary global landscape. However, the rise of artificial intelligence (AI) compelled educational institutions to explore its implications. One is the QuillBot, which provides learners with an opportunity for academic output with enhanced grammar, vocabulary, and writing coherence. Despite its innate negative notion, various AI-powered language learning tools became the learners' reliable friends in improving their academic writing skills. Thus, this study aimed to explore Filipino senior high school learners' experiences and the factors affecting their utilization. This study utilized a qualitative research design and Saldaña's (2009) coding process to analyze the data gathered. Findings revealed various benefits and drawbacks of QuillBot for learners' language writing skills. The learners highlight the features that helped improve their writing skills and the possibility of overreliance on it. On the other hand, the COVID-19 pandemic, to make writing more convenient and faster, and avoiding plagiarism are the factors that emerged from the analyzed data. The pedagogical implications of incorporating the AI-powered tool QuillBot into the curricula should be investigated, emphasizing the possibility of combining AI tools with traditional teaching methods in improving the English language skills balanced with learners' critical thinking skills.
***Keywords**:* Artificial Intelligence, English language, QuillBot, Writing Skills.

*This study was presented at the 20th Annual CamTESOL Conference on English Language Teaching, Institute of Technology Cambodia (ITC) Phnom Penh, Cambodia, 23rd-25th February 2024.

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Introduction

Language is a skill; thus, to be proficient in using the language, one must first learn the skills of language (Bora, 2023). These skills are listening, speaking, reading, and writing. All of those are needed to develop effective communication skills. Mastery of these skills improves learning at the personal, academic, and professional levels. For instance, listening and speaking are interrelated to develop oral communication, while reading and writing help develop written communication (Sadiku, 2015). However, focusing on all these skills might dilute the research focus within the given time and resources. Although these skills are all vital, this study focused only on writing skills to provide more in-depth analysis. With that in mind, it is essential to first delve into the definition of writing.

Wilson (2022) simply defined writing as the "expression of thoughts." Writing is one of the essential skills that learners must acquire in language learning. It allows the learners to communicate their ideas, opinions, and experiences to others. However, several studies believed that writing is a difficult skill to master (e.g., Amyatun & Kholis, 2023; Bora, 2023; Chui, 2022; Fitria, 2021; Hiếu et al., 2022; Ishnazarovna & Krimpas, 2022; Jaladara et al., 2023). Given this situation, teachers are extending efforts to help students learn to write effectively.

However, another aspect requires consideration. The introduction of Artificial Intelligence (AI) brought opportunities and challenges to different sectors of society. One that is greatly affected by AI is the educational sectors. It is a fact that learning priorities in schools shift in response to societal and economic developments. Since then, the applications and principles of traditional teaching and learning have changed due to the advancement of technology. AI, for instance, brings the conventional way of writing instruction a second thought. Thus, experts urged educational sectors to improve the curriculum and provide frameworks where 21st-century learners can effectively engage, relate, and maximize their writing skills.

Although writing teachers started incorporating technology in the classroom, AI-powered tools catapulted them to rethink their teaching strategies. QuillBot, an AI-powered writing tool, is one of the known online writing tools that aim to assist users in creating a coherent sentence and improving overall writing quality (Singh, 2023). QuillBot is an inevitable writing tool that learners can make use of anytime and anywhere. Despite its innate negative notions (e.g., Barreiro Jr., 2023; Jamal, 2023; Reuters, 2023), students, sometimes even teachers and other professionals, make use of this writing tool.

However, limited research has been conducted to explore students' lived experiences and the factors that influenced them to use the AI-powered tool QuillBot (Kurniati & Fithriani, 2022; Xuyen, 2023; Raheem et al., 2023). Therefore, the purpose of this study is to look at the students' real-life experiences and the factors that impact their use of QuillBot. Doing this research will help the researcher understand and gain knowledge on how AI writing tools like QuillBot help students move forward into academic success. Furthermore, one cannot deny its potential in moving toward modern education.

Literature Review

Artificial Intelligence in Education (AIEd) in the Philippines

The origins of artificial intelligence can be traced back to philosophy, fiction, and imagination (Pothen, 2021). Based on the book "Learning Outcomes of Classroom Research" by Karthikeyan et al. (2021), it can be inferred that Artificial Intelligence (AI) started from the idea of computers acting and behaving like humans. In 1956, John McCarthy, one of the

founding fathers, coined the term during the Dartmouth conference that gained the attention of the researchers. AI is gaining attention as it revolutionizes how different societal sectors work, especially in education.

Additionally, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) (2023) sees AI as a potential tool that will help to address the most pressing educational concerns towards the success of Sustainable Development 4 (SDG 4). However, despite its promising human-like performance, AI is not without challenges. Some research explored the pros and cons of AI in education (e.g., Al-Tkhayneh et al., 2023; Ghosal, 2023; Idroes et al., 2023; Kengam, 2020). Moving forward, these serve as the starting point in which educational sectors should address the issues and craft policies, guidelines, or frameworks towards future ready learning.

So far, many countries have started to plan and invest in the development of AI (Fatima et al., 2021; Vaintrob, 2023). The Philippines is not an exception to this. According to Ibrahim (2022), lead convenor of the Alliance for Technology Innovators for the Nation (ATIN), the Philippines is not left behind and is in the middle of the action. In addition to this, the University of the Philippines (UP) is the first Philippine university to craft guidelines for 'responsible' AI use.

Despite the digital technology divide in the Philippines (e.g., Samortin et al., 2022), the notion of cheating and plagiarism (e.g., Ahmadi, 2020; Chandler, 2019; Peytcheva-Forsyth, 2018; Torres Diaz et al., 2021), hesitations of students and teachers to use AI (e.g., Barreiro Jr., 2023; Jamal, 2023; Reuters, 2023), the issues on digital skills readiness (World Economic Forum (WEF), 2020, as cited in Estrellado & Miranda 2023), etc. the educational sectors in the Philippines have positive view on it. The problem relies on how well the educational sectors incorporate this in the classroom setting. Thus, this study may shed light on how students view QuillBot and the factors that affect them to use it.

AI-Powered Writing Tool QuillBot

In 2017, Rohan Gupta and his co-founders David Silin and Anil Jason created QuillBot based on the belief that "learning and applying knowledge is more important than the mechanical aspects of writing" (QuillBot, n.d.). That is, writers or users may focus on what to write rather than how to write it. When it was first introduced, founders noted that people loved QuillBot, although the first version had poor quality (Ness Labs, 2023). In 2022, QuillBot gained attention with over 150 million users (Sahu, 2024). Based on the same statistics, the Philippines is one of the top 5 that have QuillBot accounts (Sahu, 2024).

QuillBot is an AI-powered writing tool that assists students in paraphrasing, summarizing, correcting grammar, plagiarism checker, translation, and citation generator. It has two available versions: free access and premium access. Baron et al. (2023) clearly explained the differences between the two available versions. Whether free or paid, many students find it helpful in improving their writing tasks (Amyatun & Kholis, 2023) and that it provides user-friendly writing features (Kurniati & Fithriani, 2022). Furthermore, different researchers found students' positive views on QuillBot (Baron et al., 2023; Hiếu et al., 2022; Kurniati & Fithriani, 2022; Nurmayanti & Suryadi, 2023; Rahmani, 2023; Xuyen, 2023). This is a good indication that QuillBot may increase students' motivation and academic performance.

Furthermore, some researches claimed QuillBot helped improve grammar (Baron et al., 2023; Hiếu et al., 2022; Mohammad et al., 2023). For instance, Baron et al. (2023) conducted a quantitative method and survey design to 35 students, which aims to improve students'

grammar skills using the QuillBot. The researchers concluded that QuillBot is useful in improving students' grammar skills.

Furthermore, some research revealed that Quillbot helped increase students' vocabulary and motivation (Jaladara et al., 2023; Mohammad et al., 2023; Mohammad et al., 2021) and helped save time in the academic writing process (Jaladara et al., 2023). On the contrary, some research noted its negative impact, such as students' dependency (Jaladara et al., 2023) and the importance of learning the basics of the English language (Fitria, 2021).

As popular as it is in the contemporary world, limited research has been conducted to explore students' lived experiences and the factors that influenced them to use the AI-powered tool QuillBot, especially in the Philippine context (Xuyen, 2023). Thus, this research is carried out to elucidate the possibilities QuillBot may offer to the educational sector, specifically to learners and teachers.

Exploring students' experiences using QuillBot and discovering the factors that influenced them to use it may provide valuable insights into their motivation, learning processes, and perceived writing effectiveness. Those insights may also reveal potential areas for enhancing educational technology integration. Furthermore, 21st-century education emphasizes a learner-centered approach, thus vital in assessing students' perspectives and assisting them towards future-ready learning. Consequently, this study aims to answer these two research questions: (1) What are the lived experiences of students in utilizing QuillBot? and (2) What factors have influenced the students to use QuillBot?

Methodology

Research Design

This study utilized a qualitative research design to explore participants' experiences and the factors affecting their decisions to use QuillBot. This research design helped highlight participants' experiences using QuillBot's free features: paraphrasing, plagiarism checker, and grammar checker. It also helped the researcher to understand and analyze their experiences (Creswell, 2014). Additionally, the study layout has sturdy philosophical foundations and typically involves completing interviews (Giorgi, 2009; Moustakas, 1994).

With that in mind, the study employed a semi-structured interview to gather the data. This provided the participants with an opportunity to share their experiences and thoughts about QuillBot. The flexibility of the semi-structured interview allows the researcher to ask follow-up questions, which may lead to a more detailed understanding of their experiences and the factors that affect their use of QuillBot in their academic writing tasks (Creswell, 2014).

Participants and Locale

This study is conducted in one of the private Universities in Manila, Philippines, during the second semester of the school year of 2022-2023. The researcher had easy access to the data collected from the student researchers, which was the reason for conducting the research at this university. This university offers three tracks (academic, sports, and Technical-Vocational-Livelihood). Under the academic track is the Science, Technology, Engineering, and Mathematics (STEM) Strand, which is where the respondents come from.

The researchers chose ten participants based on the criteria. The participants must be enrolled in this university for grade 11, five males and five females, aged 16 to 19, and use

QuillBot for their academic writing text for at least six months. The researcher used code names such as PA, PB, etc., to protect the identity of the respondents. Table 1 below illustrates the background of the respondents.

Table 1
Respondent's Background

Code Name	Age	Gender	No. of Months/Year of Using QuillBot
PA	16	Female	2 Years
PB	17	Female	1.5 Years
PC	17	Female	8 Months
PD	17	Female	2 Years
PE	17	Female	1.5 Years
PF	16	Male	2 Years
PG	16	Male	3 Years
PH	16	Male	2 Years
PI	17	Male	2 Years
PJ	17	Male	2 Years

Data Collection and Ethical Considerations

In data collection, the researcher's students initially gathered the data. This data collection allowed them to engage directly in the research process. Since the data do not belong to the researcher, the researcher asked for consent from the student researchers to use the collected data and ensured use with different aims.

The student researchers utilized a semi-structured interview to explore students' experiences and to create a free-flowing conversation with the participants. The student researchers initially created the interview questions. The researcher guided the students in developing and enhancing the interview questions. Moreover, three experts in the field of research validated the interview questions to ensure their clarity and reliability. Also, this process helped to ensure that the questions were unbiased, appropriate, and effective in capturing relevant information about the participants' experiences in using QuillBot.

In the data collection, the student researchers asked the participants to sign a consent form indicating that they agreed to participate and to publish their responses. The student researchers informed the participants about the nature, aims, and interview questions beforehand. Furthermore, they recorded the one-on-one interview sessions. The student researchers transcribed everything in Microsoft software and deleted the recorded interviews after transcribing. The researcher oversaw the whole data-gathering procedure to ensure its accuracy. With that, the researcher did the manual data analysis and had it audited for validity. Furthermore, the researcher ensured to maintain the participant's confidentiality and utmost secrecy in compliance with the Republic Act No. 10173, also known as the Data Privacy Act of 2012.

Data Analysis

The researcher used Saldaña's (2009) descriptive and vivo coding methods in the initial step. In the second step, the researcher used pattern coding to identify the themes. This method helped the researcher uncover common ideas or patterns and associate them with observable themes, making it easier to analyze all of the data received from participants (Saldaña, 2009).

Furthermore, this qualitative research approach offers valuable insights into individuals' lives and viewpoints (Saldaña, 2009). The table below shows the process of analysis using Saldaña's (2009) coding process.

Table 2
Coding Process

Research Questions	Themes	Initial Codes	Sample Responses
RQ 1. Student's Experiences	Benefits	Ease of use	"It is really easy to use because you can actually see the buttons if you visit the site; you can immediately use it, and it is organized. You [will easily recognize] what those buttons are: for summarizing, paraphrasing, etc. It somehow makes QuillBot a user-friendly." (PH)
	Drawbacks	Excessive Reliance on QuillBot	"I'll start with the disadvantages. It made me rely on it because sometimes I don't use my knowledge [for constructing grammar or paraphrasing] while using this application. I tend to just give the task to QuillBot." (PG)
RQ 2. Factors Influence the use of QuillBot	Pandemic Time	Started to use because of Covid-19	"The first time I used QuillBot was in grade 9 because of Covid-19. [Therefore], I relied too much on QuillBot because it to help me with my schoolwork. I needed to learn on my own, which was hard for me, but QuillBot has helped me with my assignments." (PA)
	Avoiding Plagiarism	To avoid plagiarism	"It was [helpful], especially for our research, since we are using it for paraphrasing and checking for plagiarism. It is fast and easy to use, and the constructed sentences that it creates are amazing. So, to avoid plagiarism, we use this app." (PF)

Findings and Discussion

This study explored Senior High School students' experiences and examined different factors influencing students to use QuillBot in their academic writing. AI-powered tools like QuillBot made educational institutions rethink the teaching and learning process. Therefore, it is reasonable to look at students' points of view, given that cheating and plagiarism have become the number one concern of teachers. Exploring students' experiences and the factors that affect their use of QuillBot would help to understand their learning motivation, learning processes, and perceived writing effectiveness. The study findings revealed how students perceived QuillBot and how it assisted their writing journey. The following discusses the study findings and discussion based on the research questions posted in the previous section.

Research Question No. 1. (RQ1) What are the lived experiences of students in utilizing QuillBot?

Based on the analyzed data, learners highlighted on their lived experiences the benefits and drawbacks of QuillBot. Two themes emerged under benefits: ease of use and improved learners' academic writing skills, output, and grades. On the other hand, students are concerned about relying too much on QuillBot, and inappropriate terms appear in the generated texts. The following section discusses these themes.

Benefits

The first theme that emerged is the ease of use. Students believed that QuillBot is easy to use or navigate. They do not have any trouble accessing it using their phones or gadgets, and that little effort is needed to understand how it works. For instance, PH and PI emphasized the features of QuillBot that help them to paraphrase or summarize the texts.

> "It is really easy to use because you can actually see the buttons if you visit the site; you can immediately use it, and it is organized. You [will easily recognize] what those buttons are: for summarizing, paraphrasing, etc. It somehow makes QuillBot a user-friendly." (PH)

> "It is indeed easy to use because you can click on the words you want to change to make them more beautiful. Then there is something at the top of the paraphrasing tool if you want it to be standard, fluent, or the other options available that can help you better with what you want to convey to your readers." (PI)

If one visits the QuillBot website, they might share the same sentiment. Based on the findings, learners find QuillBot's feature easy to navigate. They did not encounter problems accessing and using the website. This finding is consistent with the results of Kurniati and Fithriani (2022) and Amyatun and Kholis (2023), where one of the benefits highlighted is its user-friendly writing features. Additionally, this finding is consistent with the systematic review of Raheem et al. (2023), where they emphasized the different features of QuillBot that assist students in their academic writing. Looking at the other view, this may be attributed to learners' acquired knowledge on navigating and accessing technology since 21st-century learners are exposed to technology. Additionally, using technology has been part of education since it was introduced, so there is no surprise that learners would be able to access it without challenge.

The second theme pertains to learners' claim that QuillBot helped improve their academic writing skills, output, and grades. It has assisted them in summarizing, paraphrasing, and verifying grammar, allowing them to accomplish necessary writing tasks. PE and PF shared how QuillBot helped them improve their writing skills:

> "Yes. It sounds like you can explore more synonyms about that term, expound it more, and make your output [look] more professional or creative in some way. That has helped me a lot in my academic writing tasks." (PE)

> "… the words that I asked QuillBot to [paraphrase] are not very usual [to me]. It is too [unfamiliar], so of course, when paraphrasing, QuillBot will give me words that are more [easy to understand], which sounds good to read and it is easy to use wherever I need it." (PF)

In relation to that, some students believe that QuillBot has helped them enhance their grammar skills and improve their English vocabulary. Most students stated they learn by analyzing the paraphrased, enhanced text, or summarized materials.

> "Yes, it enhanced my knowledge of grammar skills. It's like I need to improve my skills to understand it. You can improve your grammar or correct it when you check it in QuillBot, and it is like you have a guide. It guides, corrects, and can improve your skills, so when you do it yourself, you already know what to do." (PI)

> "For me, yes. It improves my academic writing skills, because I analyze the paraphrased sentences, so I also learn what needs to do or what needs to change or other words that can also be used." (PD)

> "Yes, I think my writing skills improved. I find it stepping stone to improve or widen my vocabulary, and it comes to different terms so I can use it for other academic works or outputs." (PE)

Additionally, most of the participants mentioned that they often use QuillBot to paraphrase, avoid plagiarism, and summarize a text. Indeed, QuillBot offers different features that help them in their academic writing. PJ and PD emphasized how QuillBot helped to improve their academic writing and grades. To wit:

> "QuillBot really helps me to organize my grammar and paraphrase my essay in a more orderly way. Because of this, I seem to get high grades, especially in English and Science, because there are many essays in these subjects. It makes my output more beautiful because most of the words suggested by QuillBot are much better than the words I use." (PJ)

> "Yes. Since I've used QuillBot, my sentences have better structures in my essays or academic writing, so I get higher grades." (PD)

Improved learners' academic writing skills, output, and grades are other themes that emerged from the findings. Similarly, Xuyen (2023) also emphasized the positive effect of QuillBot on students' paraphrasing skills. Furthermore, learners had a favorable view of QuillBot in English, which significantly enhanced their writing skills (Amyatun & Kholis, 2023; Hiếu et al., 2022; Jaladara et al., 2023; Kurniati & Fithriani, 2022). Additionally, the writing productivity of students significantly improved with the help of QuillBot (Ellerton, 2023; Kurniati & Fithriani, 2022; Nurmayanti & Suryadi, 2023; Shabbir, 2023). The positive feedback and impact of it on learners' writing skills, output, and grades can also be attributed to its features. Despite using the free version, it provides several possibilities for students to improve their grammar and vocabulary, resulting in improved ratings.

Drawbacks

One of the preeminent drawbacks of QuillBot based on students' responses is excessive reliance on it. Most students admitted that they sometimes rely on QuillBot whenever they have writing activities or assignments. For example, PG and PB made it plain how much they relied on it.

> "I'll start with the disadvantages. It made me rely on it because sometimes I don't use my knowledge [for constructing grammar or paraphrasing] while using this application. I tend to just give the task to QuillBot." (PG)

> "Sometimes, yes. I have moments [when I rely] too much on QuillBot [and] mostly when writing my answers. Whenever we need to write, the first thing that will come to my mind is to use QuillBot. It makes me at ease." (PB)

Similarly, some studies are concerned with the potential risks of learners' overreliance on QuillBot (Gayed et al., 2022; Raheem et al., 2023; Zhai, 2022). This study and of Jaladara et al. (2023) proved that learners rely on it whenever they have academic writing tasks. On the contrary, there are some students who are aware of the potential risk of relying too much on QuillBot. Most would highly recommend it with other students, albeit with conditions. Thus, this may imply that even if they use QuillBot to generate enhanced academic writing, they can control themselves whenever they have the notion of relying on it. Therefore, the teacher's guidance is vital in this part. PC and PJ noted how helpful this tool is and the imminent risks of it. To illustrate:

> "For me, I think there are no disadvantages to using this app, but for my fellow students [who] use this application and rely on it so much that they are not learning anymore." (PC)

> "We know that not all students are fluent in the English language, so there are many of us who don't know words. With QuillBot, we can [find out] many different words that are synonymous with the words we know. I recommend it, but just don't rely too much on it where you just copy and paste it in QuillBot." (PJ)

The next theme points out inappropriate terms that appear in the generated texts. Just like any other AI tool, QuillBot has its flaws. PA, PD, and PE mentioned that there are words that are inappropriate in the sentence. Sometimes, it changes the context of the text, thus they need to double-check the paraphrased texts.

> "Even though QuillBot has paraphrased or fixed the grammar, some words don't jibe with the sentence. So, I need to reread and edit it." (PA)

> "I still analyze the texts that appear on QuillBot since, as I mentioned, sometimes QuillBot changes the context of the essay, so you still need to check it." (PD)

> "I must check the whole output [because] even though they changed some other words, there are cases that a term doesn't [fit] in my sentence or the concept of my essay." (PE)

The findings are consistent with Fitria (2021), Chui (2022), Cavaleri and Dianati (2016), and Park (2019). Just like humans who make mistakes, it is unrealistic to expect these advancements to be error-free (Bozkurt, 2023). On a lighter note, participants in this study appear to have enough understanding of how the English language works, which may be attributed to their prior knowledge. With that in mind, learners must still understand the fundamentals of the English language to evaluate the enhanced texts. QuillBot does not generate text, so it will not help the users without the slightest idea of constructing simple English sentences.

In summary, like any other technological advancement, QuillBot may assist in correcting, paraphrasing, and summarizing students' writing output because of its features, but it might also post some disadvantages. To avoid these, basic knowledge about creating sentences and background knowledge about the concepts are also vital when using QuillBot. Additionally, students should be equipped with the necessary skills to determine technological flaws. Moreover, students still need to develop critical thinking and creative skills to equip them for this kind of error.

Research Question No. 2. (RQ2) What factors have influenced the students to use QuillBot?

Exploring the factors that influenced the students to use the QuillBot is essential as it opens an opportunity to understand why students led to utilizing it, how to improve this practice ethically, and how it affects society in a larger sense. Based on the analyzed responses from the students, three factors emerged: the COVID-19 pandemic, to make writing easier and faster and avoiding plagiarism.

During the pandemic time, teaching and learning migrated to distance learning. COVID-19 indeed intensified digitalization in the academic institution. The results of this study proved this again, wherein students mentioned that they discovered QuillBot during the

pandemic. They had the opportunity to search for a tool that help them with their academic work. PF, PA, and PB explained how they discovered this tool during the pandemic:

> "Since the pandemic began and online classes have been made, I started to use QuillBot. I use QuillBot, but not very often. I only use it sometimes. And yes, it's good to use QuillBot before. It has helped me a lot." (PF)

> "The first time I used QuillBot was in grade 9 because of Covid-19. [Therefore], I relied too much on QuillBot because it to help me with my schoolwork. I needed to learn on my own, which was hard for me, but QuillBot has helped me with my assignments." (PA)

> "I've been using the QuillBot since 10th grade, which was during the pandemic. I encountered QuillBot because I've been searching for an app that I can use to paraphrase my answers to my activities." (PB)

Surprisingly, the findings of this study revealed the pandemic as one of its factors. Distant communication between teachers and students was made possible by technology even in the pre-pandemic era. Given its advantages, it is a reality that distant communication is not always enough to reach students' needs, especially during the pandemic time. It seems that COVID-19 intensified the communication presence divide. Alawamleh (2020) found the negative effects of online learning communication between students and teachers. With this, the pandemic paved the way for students to discover new tools using their gadgets and the internet, which aids in learning and producing the desired academic output.

The second factor that emerged is QuillBot makes students' writing easier and faster. One of the primary goals of AI tools is to make our lives easier and to produce an output within a few clicks. QuillBot has this feature. PC mentioned that when the activities piled up and PC likes to do assignments on time, PC always used QuillBot to create an error-free essay and to verify grammar.

> "When my tasks have piled up already, and especially when it's all about constructing error-free essays and English grammar, I use QuillBot. It saves a lot of my time." (PC)

> "I will recommend QuillBot to other students because not everyone can really [write] good essays. They can use QuillBot to make their writing process easier and faster. With just a few clicks, you'll get the desired writing output." (PD)

Some studies acknowledge the characteristic of QuillBot as making writing uncomplicated and faster (Amyatun & Kholis, 2023; Fitria, 2021; Jaladara et al., 2023; Nurmayanti & Suryadi, 2023; Xuyen, 2023). Making life easier seems to be the motto of the AI-powered tool QuillBot. In a broader sense, it offers an opportunity to do things quickly and make it convenient for its users. Despite the errors and drawbacks, it is undeniably helpful for the participants.

The last factor that affects the students to use QuillBot is to avoid plagiarism. There is vast information on the internet. Students look for a way to get ideas without plagiarizing the original content. Thus, they resorted to using QuillBot for academic writing.

> "It was [helpful], especially for our research, since we are using it for paraphrasing and checking for plagiarism. It is fast and easy to use, and the constructed sentences that it creates are amazing. So, to avoid plagiarism, we use this app." (PF)

> "QuillBot was very helpful, especially for us students working on our research. It will help them to avoid plagiarism and errors. It also helps us get citations, which is why I like it." (PG)

Information now can be reached with just few clicks; thus, the issue of plagiarism became prevalent as well. Salvagno et al. (2023) raised ethical considerations whenever learners use AI for academic purposes. Also, teachers are highly concerned about academic dishonesty brought about by AI (Mohammadkarimi, 2023). However, the study participants seem aware that plagiarism is a crime in academic writing. Thus, students resorted to using the paraphrasing and plagiarism checker (for premium) of QuillBot.

In summary, students tend to use QuillBot because of the communication divide between teachers and students during the pandemic, to make writing easier and faster and to avoid plagiarism. Furthermore, it can be garnered from the findings that as long as students are aware of their limitations and know how to utilize QuillBot, or AI in general, teachers do not need to worry as long as they are equipped with the necessary skills to handle these circumstances. On the other hand, learners must be aware that paraphrasing does not mean they did not plagiarize the content and still need to cite the sources.

Conclusion

This study was conducted to highlight students' real-life experiences and reveal factors that affect students' use of QuillBot, an AI-powered writing tool. Doing this allows us to view how students perceive online writing tools and their motivations for utilizing them. This study shed light on how students positively view QuillBot as a potential assistant in constructing their academic writing tasks. However, study findings also revealed students' overreliance on it and the occasional errors carried out by QuillBot. Although the study does not mean to generalized, it is worth noting that students must maintain vigilance on the enhanced texts that appeared in the QuillBot. Therefore, it is essential to know the fundamentals of the English language.

Furthermore, the COVID-19 pandemic, making writing convenient and faster, and avoiding plagiarism emerged as factors that influenced learners to use QuillBot. Despite the negative notions (such as overreliance and occasional errors) about QuillBot, students still use it and cannot deny its immense potential to assist them in moving toward modern education.

On the other hand, this study allowed students to express their thoughts about QuillBot. Although the study does not intend to make broad generalizations, it aims to contribute to ongoing discussions about how AI-powered writing tools like QuillBot assist students with their writing tasks and how it helps to enhance their writing skills. Additionally, this study may help to improve educational practices due to technological innovations and improve awareness about the potential risks and benefits of using such tools.

Limitations of the Study and Suggestions

The study does not mean to generalize due to its limitations, but if society embraces AI-generated products, it would be helpful if students were well-informed about the responsible utilization of AI tools, specifically QuillBot. Furthermore, adopting QuillBot or AI, in a larger sense, may require trust and critical thinking. It is possible that people will consider participating in this innovation. Thus, this study wanted to emphasize the importance of getting involved in the conversation to minimize the potential risks and address the issues concerning QuillBot. Furthermore, concerned institutions, especially educational institutions, may continue

exploring, innovating, and maximizing the potential of QuillBot in assisting students with their writing tasks.

Due to study limitations such as limited participants and time constraints in conducting the study, researchers may further investigate the pedagogical implications of incorporating the AI-powered tool QuillBot into the curricula, emphasizing the possibility of combining AI tools with traditional teaching methods in improving the English language skills balanced with students' critical thinking skills. Additionally, future researchers may conduct a similar study to a larger audience, exploring QuillBot empirically, teachers' views about Quillbot, and ethical issues and how they must be addressed. Doing this would help create future-ready learning where 21st-century students can effectively engage, relate, and enhance their writing skills.

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Research Article
Received: 12.02.2024
Accepted: 31.12.2024
Published: 31.12.2024

Citation: Akdoğan, N., & Toprak, E. (2023). The role of self-regulation and motivation in secondary school students' English self-efficacy. *International Journal of Scholars in Education*, *7*(2), 82-104. https://doi.org/10.52134/ueader.1435495

The Role of Self-Regulation and Motivation in Secondary School Students' English Self-Efficacy***

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Abstract**:** The purpose of this research is to examine the role of self-regulation and motivation in the English self-efficacy of secondary school students and to investigate their relationship with various independent variables. This research aims to identify the factors influencing English proficiency in Türkiye and contribute to the consideration of these factors in the regulations made to improve language education in order to enhance the level of English language education. The research is conducted according to the correlational survey method. The sample of the research consists of 580 secondary school students studying in state schools affiliated with the Ministry of National Education in Kayseri province in the 2022-2023 academic year. In the research, "English Language Skills Self-Efficacy Scale", "Perceived Self-Regulation Scale", "Foreign Language Learning Motivation Scale" and "Personal Information Form" were used as data collection tools. In addition to descriptive statistics, t-test, Analysis of Variance, Tukey HSD multiple comparison test, and Stepwise Multiple Regression Analysis were used for data analysis. As a result of the research, it was found that secondary school students' self-regulation skills, foreign language learning motivation, students' gender, grade level, parental education level, family income level, the place where most of their life is spent, and English report card grade were significant variables in explaining their English self-efficacy.
Keywords: Foreign language self-efficacy, Motivation, Self-regulation.

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***This study was adapted from the master's thesis prepared by the first author under the supervision of the second author.

Introduction

Language is the way in which a person conveys their feelings, thoughts, and desires using various sounds and symbols (Aydoslu, 2005). However, for individuals to communicate and interact with others in their society and from different societies, as well as to collaborate, it is only possible through mutual understanding and the use of a common language (Günday & Aycan, 2018). With globalization, the search for a common language has emerged since the beginning of the 20th century. After World War II, the political and economic power balances led to English being accepted as a global language through decisions made in international platforms such as the United Nations (Aladağ, 2017). In order to keep up with the times, learning English has been emphasized as a means to follow developments in global culture, art, science, technology, economy, and politics. Turkey has adopted a similar approach to other countries in this regard, focusing heavily on English education and teaching. Both at the societal and state levels, comprehensive efforts have been made for many years to teach and learn foreign languages (Sebüktekin, 1983). However, despite new regulations influenced by different educational policies, it is well known that students taking foreign language courses from elementary school to university face significant challenges in acquiring language skills (Demirel, 2012). The main reasons for the difficulty in learning English in Turkey include the inability to learn the language in its natural environment, the long time required to develop language skills, methodological mistakes made by English teachers from the traditional education system, the lack of appropriate content in local textbooks for language teaching, the ineffective use of assessment tools, and students' prejudices towards learning foreign languages (Yaman, 2018).

When examining the issues in the learning environment from the perspectives of cognitive, affective, and behavioral domains, it is generally observed that the focus is on the cognitive domain, and efforts are made to solve problems through this dimension. However, affective characteristics significantly impact an individual's success in the learning process (Gömleksiz, 2003). Although Ehrman & Oxford (1995) primarily relate language success to mental factors, they emphasize that affective factors actually play a larger role in language learning success. Ehrman et al. (2003) identify affective variables, such as motivation, self-efficacy, tolerance for ambiguity, and anxiety, as factors that play a crucial role in the language teaching-learning process. Self-efficacy, expressed as a belief in one's ability, regulates an individual's affective characteristics by providing them with the ability to persevere and make determined efforts in the face of difficulties during the self-regulation process (Aydın & Atalay, 2015). Therefore, to increase success in foreign language education, it is important to focus on affective factors. This study will examine the relationships between self-efficacy, motivation, and self-regulation skills-affective components of the individual—in the context of English language success. First, it would be useful to briefly explain these three concepts.

Self-Efficacy

The concept of self-efficacy, which has been the subject of many studies, is based on the principle of reciprocal determinism from Albert Bandura's social-cognitive theory. According to this principle, an individual's behavior, personal characteristics, and environment mutually influence each other, and these interactions determine the individual's subsequent behavior (Bandura, 1986). Through this reciprocal determinism, individuals can develop a kind of self-regulatory mechanism to organize their lives. In this way, individuals are able to generate new ideas, make judgments about their experiences, and form expectations for the future (Yazgan-İnanç & Yerlikaya, 2016). Self-efficacy is a personal factor, consisting of cognitive, affective, and biological components, that plays a crucial role in the functioning of reciprocal determinism (Bandura, 1997). Self-efficacy is an individual's judgment of their ability to regulate their own behaviors to accomplish a particular task in any field, their belief that they can carry out necessary actions within a plan, and their self-judgment regarding whether they

possess the capacity to successfully execute these tasks (Bandura, 1982). The belief in self-efficacy determines how an individual will respond to negative situations they encounter in their daily life (Bıkmaz, 2002). Baron (2004) suggests that there are three types of self-efficacy: self-regulatory, social, and academic. Self-regulatory self-efficacy helps individuals avoid taking major risks in daily life, prevent putting themselves in danger, and resist social pressures. Social self-efficacy helps an individual adapt to their environment. Lastly, academic self-efficacy relates to the ability to regulate learning activities and establish reasonable academic expectations. Students' perceptions of self-efficacy directly affect their academic success, and these differences are also evident in language success (Hsieh & Schallert, 2008). Foreign language self-efficacy, in particular, refers to individuals' self-assessments regarding their ability to perform the necessary actions in an organized manner to achieve success in foreign language courses (Yanar, 2008).

Perceived Self-Regulation

Self-regulation is a learning model in which the learner engages in activities such as repetition, adding new knowledge to what has been learned, summarizing, creating schemas, and using various learning strategies. It involves reviewing the learning process, updating goals, and setting new objectives (Zimmerman, 1989). This model was initially developed to determine how students regulate and shape their own learning (Zimmerman, 2008). Academic self-regulation, also known as self-regulated learning, refers to behaviors such as writing or studying for an exam, engaging in goal-oriented actions, and the spontaneous generation of ideas and emotions to achieve success in the educational process (Zimmerman et al., 1996).

Pintrich (2000) defined self-directed learning in four key stages: forethought, monitoring, control, and reflection. Self-regulation exercises are carried out in each of these four areas: cognitive, motivational, emotional, behavioral, and contextual. To explain these concepts: the forethought category involves activating metacognitive knowledge, beliefs about competence, goal setting, and an awareness of when and what tasks need to be done. The monitoring stage refers to awareness and mental tracking, motivation, sensory monitoring, time management, effort, and content knowledge. The control category involves determining the strategies needed for learning, reasoning, motivation, effort, and planning tasks. The final category, reflection, involves evaluating mental schemas, emotional responses, choosing the most appropriate approach, and assessing the tasks and content (Cheng, 2011).

Foreign Language Motivation

Motivation is the force that initiates, sustains, and regulates an action, enabling the student to actively engage in learning and act according to their attitude (Pintrich & Schunk, 2002). Foreign language motivation refers to an individual's enthusiasm for learning a foreign language, and the enjoyment derived from language learning further enhances their desire to learn (Gardner, 1985).

Motivation to learn English is derived from three main sources: intrinsic interest, external factors, and success. Intrinsic interest refers to the spontaneous desire to learn a language that arises during the process of learning a foreign language. External factors are elements that motivate an individual due to positive feedback received from an outside source during the language learning process. The final source, success, is defined as a student's positive self-perception related to their language acquisition (Fisher, 1990). Gardner & Lambert (1972) identified three main reasons for the impact of motivation in foreign language learning. First, intrinsic reasons include the individual's tendency to learn a foreign language, enjoyment of the process, and the desire to speak the language. Second, instrumental reasons include goals such as pursuing an academic career, translation work, or gaining opportunities on different

platforms through proficiency in a foreign language. Finally, integrative reasons refer to the desire to reach a professional level in a foreign language in order to get to know other cultures and communicate with people from different regions.

The Purpose and Importance of the Study

Since language learning is a comprehensive activity, the language learning process is influenced by many factors. According to the literature, it is observed that success in foreign language education is directly and indirectly affected by cognitive, affective, socio-economic factors, and psychomotor characteristics. Therefore, the principle that development is a whole in the teaching-learning process is a principle that should be considered in foreign language courses, just as it is in all other subjects. In this regard, it is important to provide students with a positive learning environment and support their development in terms of affective characteristics (Oğuz & Baysal, 2015). Perceived self-efficacy is one of the individual differences that addresses the affective domain in language teaching, and individuals with strong motivation in the language learning process also have higher self-efficacy beliefs (Ehrman et al., 2003). Language learning is a complex structure and a challenging process that requires dedication. Therefore, it can be said that the successful completion of this process, which requires persistence, will be possible for language learners who also have self-regulation. Taking responsibility for their own learning and engaging in individual studies can be considered a prerequisite for learning (Kahraman & Gündoğdu, 2021). Creating a system that will enhance students' self-efficacy and success in foreign language learning, the motivation necessary for the functioning of language learning, and the use of self-regulation strategies in English teaching appear to be crucial for foreign language education (Aşık, 2013; Turanlı, 2007; Vardar, 2011). However, it is important to understand how these factors interact with each other and the role they play in the learning process. Additionally, it is a shortcoming in the related literature that cognitive factors have been given more attention than affective factors in studies related to foreign language education (Gardner, 1997).

This study aims to address the affective factors such as self-efficacy, self-regulation, and motivation, which are considered important in the English learning process, and to fill a significant gap in the literature. Upon reviewing the literature, many studies examine the effect of these variables on English course success, but comprehensive research involving English self-efficacy, self-regulation, and foreign language motivation together is found to be quite limited. In this context, this study, which addresses these variables together, holds a pioneering quality in the literature. Moreover, considering that self-regulation in English classes is a rarely examined concept in the literature, and that these variables have been little explored in secondary school-level research, this study is expected to make significant contributions to the literature with its unique and comprehensive approach.

The aim of this research is to examine the role of self-regulation and motivation in secondary school students' English self-efficacy and to explore whether these characteristics show differences based on various independent variables. The research aims to contribute to the improvements made in language education by considering these factors in educational arrangements. The sub-problems of the current research are as follows:

1. "What is the level of secondary school students' English self-efficacy?"
2. "What is the level of secondary school students' self-regulation?"
3. "What is the level of secondary school students' foreign language motivation?"
4. "Do secondary school students' English self-efficacy levels show significant differences based on gender, grade level, and family income level?"
5. "Do secondary school students' self-regulation and foreign language motivation predict their English self-efficacy?"

Method

This study aims to investigate the impact of self-regulation and motivation on secondary school students' English language proficiency and examine the relationship of these traits with various independent variables. To achieve this, a "correlational survey" model, which is a subtype of the general survey model, was employed. The correlational survey model is a method designed to describe a past or ongoing situation, identify the relationships between associated variables, or predict one variable using specific others (Karasar, 2015).

Collection of Data

In the study, the "Personal Information Form," "English Language Skills Self-Efficacy Scale (Ocak, Küçükçınar and Karakuyu, 2022)" "Perceived Self-Regulation Scale **(**Arslan and Gelişli, 2015)" and "Foreign Language Motivation Scale Griffiths ve Özgür (2013)" were used as data collection instruments. After distributing the data collection instruments to students who voluntarily agreed to participate, information was provided about the purpose, scope, and content of the study and the instruments. The administration of the measurement tool took between 20 and 25 minutes; during this time, participants were given clarifications when necessary. The principle of confidentiality was strictly adhered to during the survey administration and data collection process.

Analysis of Data

In this study, descriptive statistics were used to determine the participants' English language skills self-efficacy, foreign language motivation, and perceived self-regulation levels. The differences in the overall self-efficacy and sub-dimensions of English language skills based on gender were analyzed using an independent samples t-test. To examine whether the mean scores of the English language skills self-efficacy level and its sub-dimensions differed according to other variables such as grade level and family income level, a one-way analysis of variance (ANOVA) was conducted. In cases where significant differences were found, the source of these differences was analyzed using the "Tukey HSD Test" for multiple comparisons. Moreover, multiple regression analysis was employed to determine the predictive levels of foreign language motivation and perceived self-regulation in relation to the overall English language skills self-efficacy and its sub-dimensions. SPSS was used for the multiple regression analyses.

Findings

This section of the study presents the findings. The findings obtained from the study first include descriptive statistics. After the t-test for group comparisons, analysis of variance, and Tukey HSD multiple comparison tests, the results of the multiple regression analyses are presented in sequence. Descriptive statistics for the scale scores and subscale scores used in the study are provided in Table 1.

Table 1
Secondary school students' English language skills, self-efficacy, perceived self-regulation and foreign language motivation levels

Scale and subscales	$\bar{x}$	ss	Lowest score	Highest score
English language skills self-efficacy	65,80	16,76	20,00	100,00
English reading self-efficacy	18,05	4,84	5,00	25,00
English listening self-efficacy	19,08	5,24	6,00	30,00
English speaking self-efficacy	15,88	4,88	5,00	25,00
English writing self-efficacy	12,78	4,55	4,00	20,00

Tablo 1 (cont.)				
Scale and subscales	x̄	ss	Lowest score	Highest score
Perceived self-regulation	37,65	5,79	16,00	48,00
Openness	19,25	3,02	8,00	24,00
Inquiry	18,39	3,34	8,00	24,00
Foreign language motivation	28,03	7,08	8,00	40,00
Intrinsic foreign language motivation	7,16	2,36	2,00	10,00
Extrinsic foreign language motivation	7,68	2,40	2,00	10,00
Integrative foreign language motivation	6,17	2,35	2,00	10,00
Instrumental foreign language motivation	7,01	2,27	2,00	10,00

Examining Table 1 reveals that the mean score obtained from the overall self-efficacy in English language skills scale is $\bar{x}$ = 65.81, indicating a high level of overall self-efficacy among students in English language skills. When the subdimensions of self-efficacy in English language skills are considered, the mean score for the reading skills subdimension is $\bar{x}$ = 18.05, while the mean score for the listening skills subdimension is $\bar{x}$ = 19.08. These closely related and high scores suggest that reading and writing skills are the most influential factors in the overall self-efficacy score for English language skills. These are followed by writing skills with a mean score of $\bar{x}$ = 15.89 and speaking skills with a mean score of $\bar{x}$ = 12.78.

According to Table 1, the mean score obtained from the foreign language motivation scale is $\bar{x}$ = 28.03, indicating that students demonstrate a moderate level of overall foreign language motivation. Examining the subdimensions of the scale individually reveals that students' intrinsic motivation ($\bar{x}$ = 7.16), integrative motivation ($\bar{x}$ = 6.17), and instrumental motivation ($\bar{x}$ = 7.01) are at similar and moderate levels. Additionally, the lowest motivation score in the foreign language motivation scale is found in the integrative motivation subdimension ($\bar{x}$ = 6.17), while the highest motivation score is observed in the extrinsic motivation subdimension ($\bar{x}$ = 7.68).

Examining the perceived self-regulation values in Table 1, the mean score obtained from the perceived self-regulation scale is $\bar{x}$ = 37.65. These findings indicate that students have a high level of perceived self-regulation overall. Among the two subdimensions of the perceived self-regulation scale, the openness subdimension has a high mean score ($\bar{x}$ = 19.25), making it the most influential factor on the overall mean. The mean score for the exploration subdimension, on the other hand, is moderate ($\bar{x}$ = 18.39). Furthermore, to determine whether the scores obtained from the general self-efficacy in English language skills and its subdimensions differ by gender, an independent samples t-test was conducted. The results of this analysis are presented in Table 2.

Table 2
T-test results of the average scores of the general self-efficacy level and sub-dimensions of English language skills of secondary school students according to gender

Dimensions	Gender	n	x̄	ss	t	p
English language skills self-efficacy	Woman	291	68,29	16,41	3,62	,00
	Man	289	63,30	16,74		
English reading self-efficacy	Woman	291	18,95	4,47	4,61	,00
	Man	289	17,13	5,02		
English listening self-efficacy	Woman	291	19,68	5,12	2,77	,00
	Man	289	18,48	5,30		
English speaking self-efficacy	Woman	291	16,59	4,77	3,50	,00
	Man	289	15,18	4,89		
English writing self-efficacy	Woman	291	13,06	4,37	1,49	,13
	Man	289	12,50	4,70		

An examination of Table 2 reveals that female students have higher mean scores ($\bar{x}$ = 68.29) in the general self-efficacy dimension of English language skills compared to male students ($\bar{x}$ = 63.30). Similarly, in terms of the sub-dimensions of the scale, female students also exhibit higher mean scores than their male counterparts. A t-test was conducted to evaluate the significance of the difference between the mean scores of the groups. The calculated t-value ($t[580] = 3.62$; $p < .05$) indicates that the difference in the mean scores of general self-efficacy in English language skills based on gender is statistically significant at the .05 level. However, when analyzed in terms of the sub-dimensions, no significant difference was found in the listening dimension based on gender ($t[580] = 1.46$; $p > .05$). These findings suggest that female students have significantly higher self-efficacy in English language skills compared to male students. To determine whether the scores for general self-efficacy in English language skills and its sub-dimensions differ significantly based on grade level among secondary school students, a one-way analysis of variance (ANOVA) was conducted. The results of this analysis are presented in Tables 3 and 4.

Tablo 3
The n, $\bar{x}$ and sd. values of English language skills general self-efficacy levels and sub-dimensions according to the grade levels of secondary school students

Scale and Subscales	Class level	n	$\bar{x}$	ss
English language skills self-efficacy	5th grade	132	69,14	16,12
	6th grade	131	65,45	16,97
	7th grade	170	66,67	16,86
	8th grade	147	62,13	16,42
English reading self-efficacy	5th grade	132	18,86	4,617
	6th grade	131	17,77	4,960
	7th grade	170	18,39	4,596
	8th grade	147	17,17	5,080
English listening self-efficacy	5th grade	132	20,00	4,815
	6th grade	131	18,86	5,198
	7th grade	170	19,78	5,288
	8th grade	147	17,64	5,320
English speaking self-efficacy	5th grade	132	17,27	4,891
	6th grade	131	16,12	4,672
	7th grade	170	15,57	5,008
	8th grade	147	14,80	4,623
English writing self-efficacy	5th grade	132	13,00	4,559
	6th grade	131	12,69	4,673
	7th grade	170	12,91	4,592
	8th grade	147	12,51	4,407

When Table 3 is examined; it is seen that the highest average ($\bar{x}$ = 69.14) in the general self-efficacy level of English language skills according to the grade levels of the students belongs to the 5th grade, while the lowest average ($\bar{x}$ = 62.13) belongs to the 8th grade. When the sub-dimensions of the scale are examined; it is seen that the highest average is at the 5th grade level in the listening dimension ($\bar{x}$ = 20.00), followed by the 8th grade in the listening dimension ($\bar{x}$ = 19.78), the 5th grade in the reading dimension ($\bar{x}$ = 18.86) and the 6th grade in the listening dimension ($\bar{x}$ = 18.86). The lowest average is at the 8th grade level in the writing dimension ($\bar{x}$ = 12.51). It is noteworthy that the averages in the reading and listening sub-dimensions are higher than the averages of the other two sub-dimensions and are close to each other at all grade levels. The results of the variance analysis regarding the differences in scores obtained from the general self-efficacy of English language skills and its sub-dimensions according to grade levels are given in Table 4.

Table 4
The results of the variance analysis regarding the differentiation of the English language skills general self-efficacy and its sub-dimensions according to grade levels

Scale and Subscales	Source of Variance	KT	sd	KO	f	p
English language skills self-efficacy	Between groups	3594,23	3	1198,07	4,34	,00
	Within Groups	158993,52	576	276,03		
	Total	162587,75	579			
English reading self-efficacy	Between groups	231,53	3	77,17	3,34	,01
	Within Groups	13332,01	576	23,14		
	Total	13563,55	579			
English listening self-efficacy	Between groups	505,35	3	168,45	6,29	,00
	Within Groups	15411,50	576	26,75		
	Total	15916,86	579			
English speaking self-efficacy	Between groups	448,39	3	149,46	6,47	,00
	Within Groups	13332,54	576	23,14		
	Total	13780,93	579			
English writing self-efficacy	Between groups	21,70	3	7,23	,34	,79
	Within Groups	11964,36	576	20,77		
	Total	11986,06	579			

When Table 4 is examined, it can be seen that the total score of English language skills general self-efficacy ($F(3,576) = 4.34$; $p < .05$) and the subdimensions of English language skills self-efficacy, including English reading ($F(3,576) = 3.34$; $p < .05$), listening ($F(3,576) = 6.29$; $p < .05$), and speaking ($F(3,576) = 6.47$; $p < .05$), significantly vary according to students' grade levels.

To identify the source of the significant differences between the English language skills general self-efficacy and subdimension scores and grade level averages, the "Tukey HSD Test" was used. The Tukey test results revealed that the English language skills general self-efficacy scores of 5th-grade students were significantly higher than those of 8th-grade students. The results are detailed in Table 5 ($p < .05$).

Table 5
The results of the Tukey HSD test regarding the source of the difference in the total scores of English language skills general self-efficacy and its subdimensions between grade levels

(I) Grade	(J) Grade	Difference between means (I-J)	p
5. Sınıf	8. Sınıf	7,00	,00

In Table 5, when examining the source of the difference between the English language general self-efficacy total scores across grade levels, it is observed that there is a significant difference of ,00 ($p < ,05$) between the 5th-grade English language general self-efficacy mean scores and the 8th-grade mean scores. In the sub-dimensions, the greatest difference is in writing skills, where 5th graders also outperform 8th graders ($p < .05$). These findings indicate higher English self-efficacy levels among 5th-grade students. To examine differences in English general self-efficacy and sub-dimension scores based on family income, a one-way ANOVA was conducted, with results shown in Tables 6 and 7.

Table 6
The n, $\bar{x}$ and sd. values of English language skills general self-efficacy levels and sub-dimensions according to the average monthly family income level of secondary school students

Scale and subscales	Family income level	n	$\bar{x}$	ss
English language skills self-efficacy	10,000 TL and below	181	60,87	16,59
	10001-20000 TL	210	66,02	15,33
	20001 TL and above	189	70,29	17,20

Table 6 (cont.)

Scale and subscales	Family income level	n	x̄	ss
English reading self-efficacy	10,000 TL and below	181	16,84	5,04
	10001-20000 TL	210	18,41	4,51
	20001 TL and above	189	18,79	4,79
English listening self-efficacy	10,000 TL and below	181	18,00	5,36
	10001-20000 TL	210	19,00	4,73
	20001 TL and above	189	20,21	5,45
English speaking self-efficacy	10,000 TL and below	181	14,56	4,76
	10001-20000 TL	210	15,96	4,69
	20001 TL and above	189	17,07	4,90
English writing self-efficacy	10,000 TL and below	181	11,46	4,38
	10001-20000 TL	210	12,63	4,39
	20001 TL and above	189	14,21	4,49

In Table 6, it is observed that the highest average score for English language skills general self-efficacy level ($\bar{x}$ = 70.29) belongs to the group with a monthly income level above 20,001 TL, while the lowest average score ($\bar{x}$ = 60.87) is observed in the group with a monthly income level of 10,000 TL or below. In all sub-dimensions, the highest averages were observed in participants with a monthly income level above 20,001 TL. Additionally, the highest average score in the sub-dimensions is found in the listening dimension for the above 20,001 TL income level ($\bar{x}$ = 20.21), followed by listening ($\bar{x}$ = 19.00) for the 10,001-20,000 TRY income group, reading ($\bar{x}$ = 18.79) for the above 20,001 TL income group, and reading ($\bar{x}$ = 18.41) for the 10,001-20,000 TL income group. The lowest average was observed in the writing sub-dimension ($\bar{x}$ = 11.46) for students with a monthly family income level of 10,000 TL or below. The results of the variance analysis regarding the differentiation of secondary school students' English language skills general self-efficacy and sub-dimensions based on monthly family income levels are presented in Table 7.

Tablo 7
Variance analysis results of secondary school students' English language skills general self-efficacy and sub-dimensions based on monthly family income levels.

Scale and subscales	Source of variance	KT	sd	KO	f	p
English language skills self-efficacy	Between groups	8206,55	2	4103,27	15,33	,00
	Within Groups	154381,20	577	267,55		
	Total	162587,75	579			
English reading self-efficacy	Between groups	395,80	2	197,90	8,67	,00
	Within Groups	13167,74	577	22,82		
	Total	13563,55	579			
English listening self-efficacy	Between groups	454,33	2	227,16	8,47	,00
	Within Groups	15462,53	577	26,79		
	Total	15916,86	579			
English speaking self-efficacy	Between groups	581,89	2	290,94	12,71	,00
	Within Groups	13199,04	577	22,87		
	Total	13780,93	579			
English writing self-efficacy	Between groups	705,01	2	352,50	18,03	,00
	Within Groups	11281,04	577	19,55		
	Total	11986,06	579			

When examining Table 7, it is observed that the total score for general self-efficacy in English language skills ($F(3,576) = 15.33$; $p < .05$), as well as the sub-dimensions of English language skills self-efficacy—English reading ($F(3,576) = 8.67$; $p < .05$), listening ($F(3,576) = 8.47$; $p < .05$), speaking ($F(3,576) = 12.71$; $p < .05$), and writing ($F(3,576) = 18.03$; $p < .05$)—significantly differ based on students' monthly family income levels.

To identify the source of the significant differences in secondary school students' English language skills general self-efficacy and sub-dimensions according to family income levels, a multiple comparison test, the "Tukey HSD Test," was used. The results of the Tukey test show that students with family income levels of 20,001 TL and above have significantly higher English writing self-efficacy scores than students with family income levels of 10,000 TL and below. The detailed results are presented in Table 8 ($p < .05$).

Tablo 8
Tukey HSD test results on the source of differences in total scores of general self-efficacy in English language skills and its sub-dimensions based on monthly family income levels

(I) Education level	(J) Education level	Difference between means (I-J)	p
20001TL and above	10000 TL and below	2,74	,00

In Table 8, when examining the source of the difference between English language skills general self-efficacy scores and family income level average scores, it is observed that students with a family income level of 20,001 TL and above have significantly higher English self-efficacy scores than those with a family income level of 10,000 TL and below ($p < .05$). In the sub-dimensions, a significant difference ($p < .05$) is found between the English writing self-efficacy scores of students with family income levels of 20,001 TL and above and those with family income levels of 10,000 TL and below.

The findings regarding the predictors of English language skills self-efficacy (total score and sub-dimensions) as influenced by foreign language motivation (total score and sub-dimensions) and self-regulation (total score and sub-dimensions) are presented below. Table 9 shows the results of the multiple regression analysis in predicting English language skills self-efficacy. According to Table 9, foreign language motivation and perceived self-regulation are highly and significantly related to English language skills self-efficacy ($R = .70$, $R^2 = .49$, $p < .01$). These variables explain approximately 49% of the variance in English language skills self-efficacy.

Tablo 9
Findings of multiple regression analysis for English language skills self-efficacy

Variable	B	SH_β	β	t	p
Constant	20,40	1,48	—	1,06	,00
Foreign language motivation	1,32	,08	,55	16,47	,00
Perceived self-regulation	,67	,09	,23	6,83	,00
R=.70	R^2=.49				
$F_{(2, 577)}$=278.49	p=.00				

The relative importance order of predictive variables for English language skills self-efficacy is as follows according to standardized regression coefficients (β); foreign language motivation and perceived self-regulation. The significance of regression coefficients was examined with t-test results and it was determined that foreign language motivation and perceived self-regulation variables are significant predictors for English language skills self-efficacy. An increase in foreign language motivation and perceived self-regulation scores causes an increase in English language skills self-efficacy score.

Table 10 shows the findings of the multiple regression analysis obtained in predicting English reading self-efficacy. When Table 10 is examined, it is seen that foreign language motivation and perceived self-regulation together have a moderate and significant relationship ($R = .61$, $R2 = .38$, $p < .01$) with English reading self-efficacy. These variables explain approximately 38% of the variance in English reading self-efficacy.

Tablo 10
The findings of the multiple regression analysis for English reading self-efficacy

Variable	B	SH_β	β	t	p
Constant	1,79	1,05		1,70	,08
Foreign language motivation	,32	,02	,47	12,64	,00
Perceived self-regulation	,19	,03	,22	6,11	,00
R=.61	R^2=.38				
$F_{(2, 577)}$= 177,37	p=.00				

The relative importance of the predictor variables for English reading self-efficacy, based on standardized regression coefficients (β), consists of foreign language motivation and perceived self-regulation. The significance of the regression coefficients was examined with t-test results, and it was found that both foreign language motivation and perceived self-regulation are significant predictors for English reading self-efficacy. An increase in foreign language motivation and perceived self-regulation scores leads to an increase in English reading self-efficacy scores.

Table 11 shows the findings of the multiple regression analysis for predicting English listening self-efficacy. As seen in Table 24, foreign language motivation and perceived self-regulation together have a moderate and significant relationship with English listening self-efficacy ($R = .60$, $R^2 = .36$, $p < .01$). These variables explain approximately 36% of the variance in English listening self-efficacy.

Tablo 11
The findings of the multiple regression analysis for English listening self-efficacy

Variable	B	SH_β	β	t	p
Constant	1,50	1,15		1,30	,19
Foreign language motivation	,33	,02	,45	11,91	,00
Perceived self-regulation	,21	,03	,24	6,39	,00
R=,60	R^2=,36				
$F_{(2, 577)}$= 167,25	p=,00				

The relative importance of predictor variables for English listening self-efficacy, based on standardized regression coefficients (β), is shown to be foreign language motivation and perceived self-regulation. T-test results for the regression coefficients indicated that both foreign language motivation and perceived self-regulation are significant predictors of English listening self-efficacy. An increase in foreign language motivation and perceived self-regulation scores leads to an increase in English listening self-efficacy scores.

Table 12 shows the findings of the multiple regression analysis for predicting English speaking self-efficacy. According to Table 12, foreign language motivation and perceived self-regulation together have a moderate and significant relationship with English speaking self-efficacy ($R = 0.68$, $R^2 = 0.38$, $p < 0.01$). These variables explain approximately 38% of the variance in English speaking self-efficacy.

Tablo 12
The findings of the multiple regression analysis for English speaking self-efficacy

Variable	B	SH_β	β	t	p
Constant	-,57	1,06		-,53	,59
Foreign language motivation	,32	,02	,47	12,57	,00
Perceived self-regulation	,19	,03	,23	6,23	,00
R=,68	R^2=,38				
$F_{(2, 577)}$= 177,89	p=,00				

The relative importance of predictor variables for English speaking self-efficacy, based on standardized regression coefficients (β), consists of foreign language motivation and perceived self-regulation. T-test results show that both variables are significant predictors of English speaking self-efficacy. An increase in foreign language motivation and perceived self-regulation scores leads to higher English speaking self-efficacy scores.

Table 13 presents the multiple regression analysis findings for predicting English writing self-efficacy. It shows a moderate and significant relationship ($R = .57$, $R^2 = .33$, $p < .01$) between foreign language motivation, perceived self-regulation, and English writing self-efficacy. These variables explain about 33% of the variance in English writing self-efficacy.

Tablo 13
The findings of the multiple regression analysis for English writing self-efficacy

Variable	B	SH_β	β	t	p
Constant	,80	1,02		,77	,43
Foreign language motivation	,34	,02	,53	13,64	,00
Perceived self-regulation	,06	,031	,08	2,11	,03
R=.57	R^2=.33				
$F_{(2, 577)}$= 142,55	p=.00				

The relative importance of predictor variables for English writing self-efficacy, based on standardized regression coefficients (β), consists of foreign language motivation and perceived self-regulation. T-test results show that both variables are significant predictors of English writing self-efficacy. An increase in foreign language motivation and perceived self-regulation scores leads to higher English writing self-efficacy scores.

Table 14 presents the multiple regression analysis findings for predicting English language skills self-efficacy. It shows a high and significant relationship ($R = .71$, $R^2 = .51$, $p < .01$) between intrinsic motivation, extrinsic motivation, integrative motivation, instrumental motivation, openness, and exploration, and English language skills self-efficacy. These variables explain about 51% of the variance in English language skills self-efficacy.

Tablo 14
The findings of the multiple regression analysis for English language skills self-efficacy

Variable	B	SH_β	β	t	p
Constant	5,88	3,34		1,75	,07
Intrinsic foreign language motivation	2,31	,27	,32	8,45	,00
Extrinsic foreign language motivation	,62	,24	,09	2,57	,01
Integrative foreign language motivation	1,59	,24	,22	6,44	,00
Instrumental foreign language motivation	,73	,26	,09	2,81	,00
Openness	,75	,22	,13	3,34	,00
Inquiry	,48	,19	,09	2,47	,01
R=.71	R^2=.51				
$F_{(6,573)}$= 99,25	p=.00				

The relative importance of the predictor variables for English language skills self-efficacy, based on standardized regression coefficients (β), includes foreign language intrinsic motivation, foreign language integrative motivation, openness, foreign language instrumental motivation, curiosity, and foreign language extrinsic motivation. T-test results show that these variables are significant predictors for English language skills self-efficacy. An increase in these variables leads to higher self-efficacy scores in English language skills.

Table 15 shows the findings of the multiple regression analysis for predicting English reading self-efficacy. The results indicate a moderate and significant relationship between

foreign language intrinsic motivation, foreign language extrinsic motivation, foreign language instrumental motivation, openness, and curiosity with English reading self-efficacy ($R = .64$, $R^2 = .41$, $p < .01$), while no significant relationship was found with foreign language integrative motivation. These variables explain about 41% of the variance in English reading self-efficacy.

Tablo 15
The multiple regression analysis findings for English reading self-efficacy

Variable	B	SH_β	β	t	p
Constant	2,54	1,05		2,41	,01
Intrinsic foreign language motivation	,78	,08	,38	9,09	,00
Extrinsic foreign language motivation	,16	,07	,08	2,19	,02
Integrative foreign language motivation	,06	,07	,03	,88	,37
Instrumental foreign language motivation	,27	,08	,12	3,33	,00
Openness	,17	,07	,11	2,46	,01
Inquiry	,15	,06	,10	2,51	,01
R=.64	R^2=.41				
$F_{(6,573)}$= 67,97	p=.00				

The relative importance of predictor variables for English reading self-efficacy, based on standardized regression coefficients (β), includes foreign language intrinsic motivation, instrumental motivation, openness, curiosity, external motivation, and integrative motivation. T-test results show that intrinsic motivation, external motivation, instrumental motivation, openness, and curiosity are significant predictors of English reading self-efficacy, while integrative motivation is not. An increase in scores for intrinsic motivation, external motivation, instrumental motivation, openness, and curiosity leads to higher English reading self-efficacy scores, while an increase in integrative motivation decreases these scores.

Table 16 presents the results of multiple regression analysis for predicting English listening self-efficacy. The analysis shows that foreign language intrinsic motivation, integrative motivation, instrumental motivation, openness, and curiosity have a moderate and significant relationship with English listening self-efficacy ($R = .61$, $R^2 = .38$, $p < .01$), while external motivation does not. These variables explain approximately 38% of the variance in English listening self-efficacy.

Tablo 16
The multiple regression analysis findings for English listening self-efficacy

Variable	B	SH_β	β	t	p
Constant	2,08	1,17		1,77	,07
Intrinsic foreign language motivation	,49	,09	,22	5,18	,00
Extrinsic foreign language motivation	,11	,08	,05	1,39	,16
Integrative foreign language motivation	,53	,08	,23	6,09	,00
Instrumental foreign language motivation	,18	,09	,08	2,01	,04
Openness	,23	,08	,13	2,97	,00
Inquiry	,18	,06	,11	2,67	,00
R=.61	R^2=38				
$F_{(6,573)}$= 59,03	p=.00				

The relative importance of the predictor variables for English listening self-efficacy, based on standardized regression coefficients (β), includes foreign language integrative motivation, intrinsic motivation, instrumental motivation, external motivation, openness, and curiosity. The analysis found that intrinsic motivation, integrative motivation, instrumental motivation, openness, and curiosity are significant predictors, while external motivation is not. Increases in intrinsic motivation, instrumental motivation, openness, and curiosity lead to higher English listening self-efficacy scores, while higher external motivation scores result in lower self-efficacy.

Table 17 shows the findings of multiple regression analysis obtained in predicting English speaking self-efficacy. When Table 17 is examined, it is seen that foreign language intrinsic motivation, foreign language extrinsic motivation, foreign language integrative motivation, openness and search together have a moderate and significant relationship (R=.63, R2=.40, p<.01) with English speaking self-efficacy; however, there is no significant relationship between foreign language instrumental motivation and English speaking self-efficacy. These variables explain approximately 40% of the variance in English speaking self-efficacy.

Tablo 17
The multiple regression analysis findings for English speaking self-efficacy

Variable	B	SH_β	β	t	p
Constant	,09	1,07		,09	,92
Intrinsic foreign language motivation	,56	,08	,27	6,46	,00
Extrinsic foreign language motivation	,20	,07	,10	2,63	,00
Integrative foreign language motivation	,50	,07	,24	6,39	,00
Instrumental foreign language motivation	,00	,08	,00	,09	,92
Openness	,23	,07	,14	3,15	,00
Inquiry	,13	,06	,09	2,19	,02
R=.63	R^2=.40				
$F_{(6,573)}$= 65,20	p=.00				

The relative importance of predictor variables for English speaking self-efficacy, based on standardized regression coefficients (β), is as follows: intrinsic motivation, integrative motivation, openness, extrinsic motivation, search, and instrumental motivation. T-test results revealed that intrinsic, extrinsic, and integrative motivation, along with openness and search, were significant predictors, while instrumental motivation was not. Increasing intrinsic, extrinsic, integrative motivation, openness, and search scores boosted self-efficacy, while higher instrumental motivation scores led to a decrease in self-efficacy.

Table 18 presents the findings from the multiple regression analysis conducted to predict English writing self-efficacy. Upon examining Table 18, it can be seen that intrinsic motivation, integrative motivation, and instrumental motivation together have a moderate and significant relationship with English writing self-efficacy (R = .58, R2 = .34, p < .01). However, there is no significant relationship between extrinsic motivation, openness, and search with English writing self-efficacy. These variables explain approximately 34% of the variance in English writing self-efficacy.

Tablo 18
The multiple regression analysis findings for English writing self-efficacy

Variable	B	SH_β	β	t	p
Constant	1,15	1,05		1,10	,27
Intrinsic foreign language motivation	,46	,08	,24	5,39	,00
Extrinsic foreign language motivation	,13	,07	,07	1,77	,07
Integrative foreign language motivation	,48	,07	,25	6,29	,00
Instrumental foreign language motivation	,26	,08	,13	3,25	,00
Openness	,11	,07	,07	1,63	,10
Inquiry	,00	,06	,00	,13	,89
R=.58	R^2=.34				
$F_{(6,573)}$= 50,16	p=.00				

The order of importance of predictor variables for English writing self-efficacy, based on standardized regression coefficients (β), is as follows: foreign language integrative motivation, intrinsic motivation, instrumental motivation, openness, extrinsic motivation, and search. T-test results showed that intrinsic, integrative, and instrumental motivations were significant predictors, while extrinsic motivation, openness, and search were not. Increases in

intrinsic, integrative, and instrumental motivation scores led to higher self-efficacy, while increases in extrinsic motivation, openness, and search led to lower self-efficacy scores.

Conclusion and Discussion

In this study, the first step was to assess the level of English language skills self-efficacy of secondary school students. The research results showed that secondary school students had a high level of perceived English self-efficacy. In the subdimensions of the scale, it was concluded that students had high self-efficacy in English reading and listening skills, and moderate self-efficacy in speaking and writing skills. Especially the results obtained from the subdimensions of the scale are as expected, as reading and listening are considered input processes in language skills, while speaking and writing are regarded as output processes. A review of the literature revealed studies on English language skills and self-efficacy, but these studies do not assess secondary school students' English language skills self-efficacy. To conduct this study with secondary school students, the "English Language Skills Self-Efficacy Scale" developed by Ocak, Küçükçınar & Karakuyu (2022) was used. Therefore, the results obtained in this study regarding English language skills will be compared with the results of studies conducted with students from other educational levels. In this context, the following studies, which show similarities with the results obtained from this research, were identified in the literature: Torres (2011) found that high school students had high self-efficacy beliefs in listening and reading skills, while having moderate self-efficacy in writing and speaking skills. The researcher suggested that this result might stem from writing being the most difficult skill requiring different sub-skills among language skills. Additionally, based on participants' moderate confidence in completing English speaking and writing tasks, the researcher evaluated that these two communication skills were not sufficiently emphasized in the classroom. Considering that communication skills affect each other, the researcher stressed that equal focus should be placed on all language skills. Çeliköz & İlbeği (2020) found that English preparatory students had higher self-efficacy beliefs in reading and listening skills than in speaking and writing skills. They explained this with the higher likelihood of being exposed to stimuli that support perceptual skills and reading abilities. Tılfarlıoğlu & Cinkara (2009) reached a conclusion that English self-efficacy beliefs were high in preparatory class students. Kitikanan & Sasimonton (2017) found similar results in their study with university students. Additionally, Kesen Mutlu, Solhi Andarab & Karacan (2019) also noted that students' self-efficacy levels were high in their research. In Çetintaş & Berkant's (2021) study, they found that high school students' English self-efficacy perceptions were above average.

Studies showing different results can be listed as follows: Aykol (2017) found that high school students had moderate English self-efficacy beliefs in his study. Zhu & Gong (2020) found that university students had moderate overall English self-efficacy in their study. In the study by Wang & Huang (2014), which examined elementary school children's use of self-efficacy beliefs and self-regulated learning strategies during the process of learning English as a second language, it was determined that English self-efficacy was at a moderate level. Similarly, Oğuz & Baysal (2015) found that high school students had moderate self-efficacy beliefs regarding their English skills in their study examining the relationship between foreign language anxiety and English self-efficacy beliefs.

Contrary to this study, Taşdemir (2018) found that in his research with high school students, most of the students had low overall English self-efficacy and low self-efficacy beliefs for the four skills. The study mentioned that the reason for the participants' low English self-efficacy was due to a lack of vocabulary knowledge. In Rahemi's (2007) study, which examined the English self-efficacy beliefs of students studying in the field of humanities and their effect on their English achievements, it was found that the students had very low English self-efficacy and held some negative beliefs about their academic abilities as foreign language learners.

Similar findings were also found in Yanar's (2008) study, which measured the English self-efficacy levels of high school students.

The study also concluded that the perceived self-regulation level of secondary school students was high. While the students' self-regulation was high in the search dimension of the scale, it was at a moderate level in the openness dimension. It is possible to come across other studies in the literature that are similar and different from the results of this study. In parallel with the results of this study, in the study conducted by Harrison & Prain (2009) with 8th grade secondary school students, it was determined that most of the students used self-regulation strategies at a high level in English lessons. In the study conducted by Kanat & Kozikoğlu (2018) with students at the same level, it was concluded that the students used self-regulation strategies for English lessons at a moderate level. In the study conducted by Mutweleli (2014) on secondary school students, it was concluded that the students' self-regulation skills were at a moderate level.

Another variable addressed in this study is foreign language motivation levels. The research found that students had a moderate level of language motivation. When evaluating students' foreign language motivation in terms of its intrinsic, extrinsic, integrative, and instrumental subdimensions, it was found that only extrinsic motivation was high, while the other motivation levels were at a moderate level. This result indicates that students' language motivation was not at the expected level. The lack of interest in foreign languages among secondary school students may be linked to their lack of awareness about the social and professional benefits of language learning. It appears that students' motivation to learn a language is often shaped by external factors, such as exam success or expectations of rewards. Additionally, the inability to learn a language in a natural setting, personal goals, and individual abilities may also influence this situation. When examining relevant studies, many similar studies to this one have been found. For instance, in a study by Dilshad, Nausheen & Ahmed (2019) that aimed to investigate secondary school students' motivation to learn English and identify factors that reduce their motivation, it was determined that students' motivation to learn English was at a moderate level. The main factors that reduced students' motivation to learn English were found to be lack of confidence, problems in speaking English, and weak grammar knowledge. Mehdiyev et al. (2016) also examined university students' motivation to learn a language and found that the majority of students had moderate or high levels of motivation. The study attributed students' lack of eagerness to learn a language to factors such as lack of interest, compulsory learning, not seeing the necessity of language in their professions, and a lack of opportunities for sufficient practice.

Unlike the findings obtained from this study, in the study conducted by Nguyen (2019) with university students to reveal the type and level of motivation in English language learning, it was found that the students' motivation to learn English as a foreign language was high. It was concluded that the students tended to learn English for instrumental reasons such as finding a job or getting an English certificate. In the study conducted by Purnama, Rahayu & Yugafiati (2019) to measure the level of motivation of eighth-grade students to learn English, it was found that the students had high motivation. In the study conducted by Becirovic (2017) with 5th, 9th, and 12th-grade students, it was concluded that the students' level of motivation in English was high. It can be thought that the high level of motivation in this study is due to the fact that the students in the sample group are older and that this age group has a better understanding of the importance of learning English.

This study also aimed to examine the effects of secondary school students' gender, grade level, and their families' average monthly income on their English language skills self-efficacy beliefs. The research found a trend in favor of female students in terms of overall English language skills self-efficacy and in the subdimensions of reading, listening, and speaking. The superiority of female students in language skills may be due to their natural

inclination towards language learning and their greater exposure to language interactions. Studies in the literature support this result (Arslan, 2018; Huang, 2013; Mahyuddin et al., 2006; Ocak & Akkaş Baysal, 2016; Oğuz & Baysal, 2015). However, there are also studies in the literature that found the self-efficacy levels of male students to be higher, which contrasts with the findings of this study (Ergür, 2016; Necan, 2019). Additionally, some studies have found results indicating that gender does not have an effect on English self-efficacy levels, contrary to the current findings (Güç, 2019; Güler Oğuz, 2019; Gürcan, 2021; İlbeği & Çeliköz, 2020; Sevimbay, 2016; Tuncer & Akmençe, 2019).

When the English self-efficacy levels of secondary school students were examined by grade level, significant differences were found in the overall English self-efficacy score and in the self-efficacy scores related to the subdimensions of English listening, reading, and speaking. According to the findings, grade level has a significant impact on English self-efficacy, except for the writing subdimension. The differentiation observed is attributed to the average English writing self-efficacy scores of 5th and 8th-grade students, with 5th-grade students exhibiting higher self-efficacy levels than their 8th-grade counterparts. This could be due to the lighter curriculum in 5th grade compared to 8th grade, as well as 8th-grade students' feelings of inadequacy in class due to their unsatisfactory performance in practice tests for the high school entrance exams. Some studies in the literature support this finding. For instance, Gürbüztürk & Şad (2009) and Bozkurt (2017) found significant differences in self-efficacy levels based on grade level. Similarly, Oğuz & Baysal (2015) observed that students' English self-efficacy beliefs were higher in the lower grades, but decreased by the 11th and 12th grades. This suggests that as grade levels increase, students' perceived importance of English decreases. Bozkurt & Ekşioğlu (2018) found significant differences in favor of 10th-grade students. In contrast, Tuncer & Akmençe (2019) concluded that English self-efficacy beliefs did not significantly differ based on grade level.

According to the findings obtained from the research, the English self-efficacy levels of secondary school students show a significant difference according to the average monthly family income. However, it was determined that the English writing self-efficacy of students whose family income level is 20001 TL and above is higher than that of students whose family average monthly income level is 10000 TL and below. Based on these findings, it can be said that as the family income level increases, the foreign language self-efficacy levels of students also increase. Since families with high income levels provide their children with more educational opportunities, this may contribute to the increase in the self-efficacy levels of students. Satıcı (2013) states that a good economic situation increases people's living standards and that they are likely to have more opportunities in environments where they can develop themselves. He also states that they can have more opportunities to meet their educational needs and increase their academic self-efficacy by gaining more educational experience. The findings of the studies conducted by Berkant & Çetintaş (2021) and İlgar (2019) are similar to the findings of this study. Aykol (2017) also concluded that high school students with a family income of 4000-5000 TL and above 6000 TL have higher English self-efficacy beliefs compared to students with lower family income levels. Contrary to this study, Bozkurt & Ekşioğlu (2017) and Çimen (2011) determined that students' English self-efficacy beliefs are not related to family income status.

The results of the stepwise multiple regression analysis conducted to determine the predictive power of the variables on English self-efficacy, as part of the study's aim, showed that foreign language motivation and perceived self-regulation have a high level of significant relationship with English language skills self-efficacy. These findings suggest that foreign language motivation and perceived self-regulation are critical factors in determining students' English language skills self-efficacy. The relationship between motivation and self-efficacy can be summarized as follows: a student with high foreign language motivation effectively explores

ways and resources to learn the language. This effort enhances their academic success, reinforcing their English self-efficacy beliefs. When considering the importance of the variables predicting English self-efficacy, foreign language motivation comes first, followed by perceived self-regulation. A review of the literature reveals that no studies have simultaneously examined the three variables addressed in this research. This makes the study unique. However, studies investigating these variables in pairs can be found in the literature. For example, Torres & Alieto (2019) found a significant relationship between English self-efficacy beliefs and language learning motivation in their study with high school students. Özdemir & Karafil (2017) and Piniel & Osizer (2013) found a significant relationship between students' language motivations and general self-efficacy beliefs. Studies by Basco & Han (2016) and Husain (2014) also identified that students' general motivations have an effect on their self-efficacy levels. Based on these findings, it can be suggested that developing motivated learning behaviors in students can influence how they process their language learning experiences and the self-efficacy beliefs they develop. In contrast to the results of this study, Ersanlı (2015) found a low-level negative relationship between 8th-grade students' English learning motivation and self-efficacy beliefs. Consistent with the findings of this study, several studies in the literature have found a positive relationship between English self-efficacy and self-regulation (Magogwe & Oliver, 2007; Su et al., 2018). This shows that students' confidence in their abilities is related to their capacity to guide and regulate their learning process. This suggests that students' beliefs in their self-efficacy could help them adopt more effective learning strategies and achieve success. In terms of the sub-dimensions of the scale, a moderate relationship was found between reading, listening, and speaking sub-dimensions with motivation and self-regulation. This indicates that students' self-efficacy in these skills is moderately related to their levels of motivation and self-regulation. However, a high-level and significant relationship was found between the writing sub-dimension and motivation and self-regulation. This suggests that students' self-efficacy in writing skills is more strongly related to their levels of motivation and self-regulation. In a study by Cho, Y. A., and Kim, Y. (2019) with high school students, a positive relationship was found between students' self-efficacy beliefs and self-regulated learning strategies, with the highest relationship being in writing proficiency. This finding, similar to the results of the current study, shows that students' self-efficacy beliefs about their writing skills most strongly affect their confidence in using self-regulation strategies during the learning process. In other words, students' beliefs in their writing abilities play a crucial role in determining their confidence in regulating and implementing their study strategies during the learning process.

Another issue addressed in the study is the predictive power of the sub-dimensions of students' foreign language motivation (intrinsic, extrinsic, integrative, and instrumental) and perceived self-regulation (openness and search) in forecasting English self-efficacy. The results of the six-step regression analysis showed that the sub-dimensions of foreign language intrinsic motivation, extrinsic motivation, integrative motivation, instrumental motivation, openness, and search significantly predicted English language skills self-efficacy at a high level. Similarly, in a study by Buch et al. (2015), it was found that self-efficacy beliefs significantly influenced students' intrinsic motivation levels, particularly.

Finally, a more detailed examination was conducted to determine whether the sub-dimensions of the independent variables (foreign language motivation and perceived self-regulation) predicted the sub-dimensions of English self-efficacy (reading, listening, speaking, and writing). The results indicated that all independent variable sub-dimensions, except for integrative motivation in foreign language, were significant predictors for English reading self-efficacy. The lack of influence of integrative motivation on reading skills may be due to the student not viewing it as a skill for communicating or integrating with the community of the target language. In the English listening self-efficacy sub-dimension, it was found that only the sub-dimension of extrinsic motivation in foreign language was not a significant predictor. This could be related to the fact that listening skills are not assessed when students receive grades in

English lessons. Additionally, the fact that students do not engage in activities such as watching English films, listening to music, or conversing with foreigners outside the classroom may have contributed to this result. In the English speaking self-efficacy sub-dimension, it was found that none of the sub-dimensions had a significant role except for instrumental motivation in foreign language. In speaking skills, this could be explained by the limited opportunities for students to use the language outside of class, or the absence of situations that require speaking English, which may account for the lack of effect of extrinsic motivation on this skill. For the English writing self-efficacy sub-dimension, it was found that neither foreign language extrinsic motivation nor the sub-dimensions of perceived self-regulation had a significant effect. Regarding the writing dimension, it can be expected that students do not feel the need for motivation or a search for developing their writing skills, as writing is a less emphasized skill in classroom settings. These analyses highlight the diversity and importance of the factors that affect English language skills self-efficacy. In contrast to the findings of this study, İlgar (2019) found a significant relationship between English self-efficacy total scores and demotivation total scores, while no relationship was found between motivation and self-efficacy beliefs when examined in terms of total scores.

Based on the findings of the research, the following recommendations can be made in the current research:

Students' motivation to learn English depends on their understanding of the language's importance in social and professional life. Therefore, teachers should raise awareness by providing examples of the language's uses and benefits in class. Emphasizing the value of English in areas such as business, academic careers, and travel can enhance students' motivation. Approaches that encourage students to focus on their own interests and goals can help support their intrinsic motivation.

Effective strategies should be implemented to strengthen students' self-efficacy beliefs in writing and speaking. These include providing practice opportunities and interactive activities with real-life scenarios to boost their confidence. Increasing motivation and improving self-regulation can also be crucial for enhancing students' English writing skills.

To enhance the impact of integrative motivation on English reading skills, exposure to the target language culture should be increased, teaching methods that promote integrative motivation should be used, and steps should be taken to foster a sense of belonging and attachment in students.

Students should be encouraged to engage in activities outside of class, such as watching English movies, listening to music or podcasts, and interacting with foreigners, to improve their listening skills. To enhance the effect of instrumental motivation on speaking, classroom activities should include real-life speaking experiences, such as interviews, negotiations, and presentations. Similar studies examining English self-efficacy at the secondary school level can contribute to the field. Studies using a mixed design could be conducted to better understand the impact of affective factors in language education.

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Research Article
Received: 15.05.2024
Accepted: 15.09.2024
Published: 31.12.2024

Citation: Saglam, Y. & Gunes, N. (2024). How do middle school students perceive Sociocultural Dialectic Method?. *International Journal of Scholars in Education*, *7*(2), 105-115. https://doi.org/10.52134/ueader.1484709

How do Middle School Students Perceive the Sociocultural Dialectic Method?

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***Abstract*:** The present study sought to explore how students perceive the Sociocultural Dialectic Method (SDM). A phenomenological case study approach was employed in gathering and analyzing the data. The study focused on the students' lived experiences of two classroom settings: one representing the teacher's regular classroom, and the other representing the classroom where the SDM is implemented. A total of 20 middle school students volunteered and participated in the study. Individual interviews were conducted, recorded, and later transcribed. The transcriptions were then analyzed inductively to discover patterns in the data. The results indicated all students found the class conducted with the SDM to be superior in terms of comprehension, retention, experience, participation, and enjoyment. To specify further, all students stated that they learned better in the class where the SDM was in use. In other words, without exception, the students found the SDM to be a superior method for learning. Further to that, 90% of the students claimed that they had the opportunity to observe the phenomenon in the class where the SDM was used and stated that their participation in this class was higher. 20% of the students found the class with the SDM more enjoyable. Also, a similar number of students (20%) expressed that what they learned in this class was more unforgettable.

Keywords: Sociocultural Dialectic Method, SDM, Phenomenology, Hands-on activity.

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***Note that this study was based on the data obtained from the master's thesis conducted by Nevzat Gunes.

Introduction

Today's education system is continuously advancing, propelled by a combination of theoretical advancements and the wealth of research data at our disposal. With each passing day, we find ourselves armed with a greater understanding of educational principles and practices. This enhanced knowledge empowers us to navigate the intricacies of the classroom environment more adeptly and to foster meaningful communication with our students. Beyond simply imparting knowledge, we now recognize the importance of nurturing a range of cognitive skills in our students, including problem-solving, creativity, and entrepreneurship, alongside their conceptual development. This comprehensive understanding of educational objectives allows us to tailor our teaching methods more effectively to meet the diverse needs of our learners.

However, the challenge lies not only in acquiring this knowledge but also in synthesizing it into cohesive instructional approaches that can be readily applied in practice. It is essential to transform these individual pieces of information into pedagogical strategies that are not only effective but also practical for everyday use in the classroom. In response to this imperative, the Socio-cultural Dialectic Method (SDM) emerges as a product of our collective awareness of the need for a more holistic approach to education. It could be seen as an instructional method fostering active learning (Lombardi, Shipley, et al., 2021) in the classroom. By drawing upon the insights gleaned from both theory and research, SDM provides a framework that integrates diverse educational principles into a unified methodology. Its aim is to facilitate a more comprehensive and effective approach to teaching and learning, thereby contributing to the continual evolution and improvement of our educational practices. In the scope of this study, our objective is to ascertain the way students perceive this innovative and assertive pedagogical approach.

Theoretical Frameworks

Sociocultural Dialectic Model

The Socio-Cultural Dialectic Method (SDM) is an instructional method developed by Yilmaz Saglam (2013, 2014, and 2019). This method is detailed in the first (2013) and second (2014) editions of the book "How Can I Teach?" and in the book "An Art of Teaching: Socio-Cultural Dialectic Method" (2019). SDM is developed based on various research outcomes and theories. According to Saglam (2019), learning occurs through an individual's participation in social and cultural activities within a specific context. This contextual nature of learning has been studied and emphasized by many researchers (Bingolbali & Monaghan, 2007; David & Watson, 2007; Lave & Wenger, 1991; Lemke, 1997; Samarapungavan, Westby, and Bodner, 2006). To them, meaning always arises from its context. For example, a real understanding of the taste of an unfamiliar fruit can only be acquired through tasting it (Sağlam, 2019) or experiencing it (Lewis, 1933).

Secondly, according to SDM, learning requires social/cultural participation or interaction. The necessity of participation is emphasized in Vygotsky's work. Vygotsky (2016) proposed that learning occurs through cultural interaction. This is akin to a child learning the rules of a game by participating in it. Games are cultural activities inherited from our ancestors, and we learn them through social interactions. According to Vygotsky (1978), this interaction occurs on two planes: first on social plane and second on psychological one. Learning therefore begins with an individual's external interaction with an adult on a social plane. This interaction then transforms into a mental (psychological) activity through internalization. In other words, dialogues once emerging from adult-child interactions on a social plane turn into internal dialogues with on the child’s mental plane. These inner dialogues later serve as tools for

individual's activity of thinking (Vygotsky, 1930), much like our feet enabling the act of walking or running. While our feet help us reach a destination, internal dialogues are used for thinking activity. Therefore, our efforts to learn or understand are fundamentally social (Wertsch, 1991). Hence, according to Vygotsky (Ibid, 1930), our mental activities are semi-social. That is, meanings or theoretical concepts we currently possess once belonged to someone else.

This approach to learning has inspired van Oers. Van Oers (2001) stated that learning is an abstraction and occurs through social interaction within a specific context. According to him, learning or abstraction occurs by drawing attention to the important elements of a context by a knowledgeable being. He called this action contextualizing action. Thus, van Oers viewed learning as an interaction between novices and experts. According to SDM, meaning is not the common/general characteristics of an object but the distinguishing features that set the object apart from other groups of objects (Cassirer, 1957). For example, in the meaning we attribute to the concept of a horse in our mind, instead of the general characteristics of horses (being warm-blooded, moving, etc.), we find important the distinguishing features that differentiate them from other animals (single hoof, long mane, short ears, long tail, long head, etc.). Therefore, the cartoon of a horse does not seem strange or foreign to us. Hence, seeing is not done with eyes but with concepts. Our concepts are our windows that enable us to see the outside world. A doctor's understanding of an X-ray film (which we cannot make sense of) by looking at it is not due to the sharpness of his eyes but to his knowledge (Chalmers, 1999).

Based on the theories and research outcomes mentioned above, SDM consists of three steps: Creating a Meaningful Context (1), Contextualizing Action (2), and Labeling (3). For example, let's say we want to teach the concept of geometric shapes. According to SDM, to create a meaningful context, geometric shapes should be brought to the classroom first. For example, toys or pictures of these shapes can be brought to the classroom. This stage is called *creating a meaningful context*. In the second stage, instead of examining each shape separately to draw attention to their differences, all shapes are placed on a wall (for example, a square, a triangle, and a circle) where children can see them altogether. To draw attention to the differences between them in terms of edge and corner properties, students are asked how they differ between these shapes. This question is vital. The responses to this question are written on the board. Students' attention is drawn to the differences (such as, unlike the circle, the sides of the square and triangle are straight; while the square has four sides, the triangle has three sides; unlike the circle, the square and triangle have corners; while the square has four corners, the triangle has three corners; the circle has no corners; the circle is not composed of straight lines; etc.). This step is called *contextualizing action*. In the final step, the teacher tells the students that the shape with four corners and edges is called a SQUARE, the one with three corners and edges is called a TRIANGLE, and the one without corners and straight lines is called a CIRCLE according to mathematicians and writes their names in capital letters above each shape. This final step is called labeling.

Phenomenology and Phenomenological Interviewing

Phenomenology serves as the guiding philosophy underpinning the data collection approach utilized in this study. As articulated by van Manen (2016), phenomenology delves into our direct experience of the world before reflection sets in. This pre-reflective experience encompasses the ordinary occurrences that constitute the fabric of our daily lives. According to van Manen, phenomenology primarily functions as a philosophical tool for inquiry rather than as a mechanism for providing definitive answers or conclusions. Through questioning, phenomenology opens pathways to new insights, understandings, and both cognitive and non-cognitive perceptions of existential realities. It sheds light on the significance of phenomena within their specific contexts.

van Manen (2016) further posits that in our day-to-day routines, we engage in habitual activities characterized by their repeatability and commonality. These routines are expressed through everyday language, which consists of words facilitating mutual understanding and communication of shared meanings. While this language suffices for describing typical situations, its reproducibility enables us to navigate daily life. Yet beneath this surface lies the realm of original thoughts and poetic imagery that breathe life into our experiences. Phenomenology aims to capture and articulate these original meanings while remaining receptive to new beginnings that shape the essence of phenomenological inquiry. Given the study's focus on exploring how students interpret their lived experiences, phenomenological interviews were conducted. These interviews aim to delve into students' lived experiences and the meanings they attribute to them.

Research Question

The objective of this study is to investigate how students perceive the Sociocultural Dialectic Method (SDM). More specifically, the aim is to reveal the disparities students perceive between their teachers' regular instructional approach and the SDM method in terms of comprehension, engagement, and other aspects as observed by the students themselves. Therefore, the following question has been investigated in this research:

What variances do students recognize when contrasting the SDM with their teachers' regular instructional approach?

Method

Before the main study, two pilot studies were conducted. In the first pilot study, students participated in two different classes, one where the SDM method was used and the other where it was not. Both classes were taught by the same teacher, the second author of this paper. Thereafter, interviews were conducted with these students. These interviews provided us with an opportunity to make additions to interview questions, remove inappropriate questions from the interview protocol, and rephrase the wording of questions in the protocol. In the second phase of the study, a decision was made to involve different instructors. While one of these instructors was permitted to employ their own teaching methodology, the other instructor, the second author, utilized the SDM. Subsequently, interviews were conducted with the students. However, as these interviews were conducted by the second author as an interviewer, students naturally expressed praise for the class delivered by them. Following this observation, it was agreed to continue the interviews with both instructors present. Surprisingly, during these subsequent sessions, it was noted that students made efforts to acknowledge and praise both teaching methodologies as well as honor both instructors. Considering this unexpected outcome, it was concluded that employing a single instructor to teach both classes would offer the most objective approach to collect data for comparing these two methodologies. Observation 1 and 2, part of the main study, consist of descriptions of the classes conducted by the second author.

Observation 1

Records from December 11, 2023, documenting the classroom session without the implementation of the SDM.

The teacher entered the classroom and provided an explanation regarding the topic to be covered. They announced, "Today, we will engage in a discussion about the propagation of sound," and wrote the unit title on the board. They instructed the students to open their

notebooks and write down what was written on the board. Furthermore, they asked a student to read from the textbook and proceeded with the reading. The teacher then provided examples related to sound and wrote the definition of sound on the board as follows: "Sound: vibrations originating from a sound source." They gave examples of sound sources, such as tapping the board with a pen or tapping the table and explained to the students that the place where the sound originates from is called the sound source. Moving to the center of the classroom, the teacher asked different students, "Could you hear my voice?" receiving affirmative responses from the students. The teacher then wrote another heading on the board regarding the characteristics of sound and instructed the students to take notes. They wrote, "The properties of sound include the fact that sound waves spread in all directions." Continuing, they wrote about the properties of sound waves. The teacher proceeded with readings from the textbook, drawing attention to visuals related to sound. There were examples in the textbook indicating that sound is transmitted in solids, liquids, and gases. By asking questions, the teacher emphasized that sound is transmitted in solids, liquids, and gases. They posed the question, "Imagine there was a gas medium between us, could you hear my voice?" to which the students responded affirmatively. The teacher stated that sound is transmitted in gases. Next, the teacher continued the narrative by asking the students to imagine metal spoons clinking together inside a container filled with water, asking if they could hear the sound. After receiving affirmative responses from the students, the teacher explained that sound is also transmitted in liquids. Then, they instructed the students to place their ears on the table and asked them if they could hear when the table was tapped. The students confirmed that they could hear it. The teacher explained that the table was solid, and sound was transmitted in solids. They then continued to write about the characteristics of sound on the board. When sound waves encountered a substance, they interacted with it. The teacher wrote about the interaction with other substances on the board. Then, they drew a visual representation of the proximity of particles in solid, liquid, and gas substances. They explained that the particles in solids were very close to each other, those in liquids were somewhat farther apart, and those in gases were much farther apart. They instructed the students to copy the visuals from the board into their notebooks. Next, they engaged in question-and-answer sessions with the students, using examples from the textbook. The teacher reiterated that sound propagated in solids, liquids, and gases. Then, they wrote about the interaction of sound with other substances on the board. "Sound was transmitted through particles," they wrote, referring to other substances. After writing about other substances, they explained that sound spread using the particles depicted in the visual they drew earlier on the board. They explained that one particle receiving sound passed it to another, and so on, thus transmitting the sound. The teacher then explained that solids had many particles, making sound transmission easy, while liquids were somewhat more difficult, and gases transmitted sound much more difficult. They explained the concept of space, where there were no particles, and thus, sound could not be transmitted. They clarified that due to the absence of particles, sound could not be transmitted in space and explained that solar explosions could not be heard.

Observation 2

Records from December 14, 2023, documenting the classroom session where the SDM was implemented.

During the SDM session, the teacher initially posed questions to the students regarding their understanding of sound. The teacher elicited responses from the students. Subsequently, the teacher wrote the unit title as "SOUND and ITS CHARACTERISTICS." Then, the topic title "Propagation of Sound" was written. The teacher inquired from the students about what substance filled the space within the classroom. The students responded with "air." The teacher then posed the question, "Could you prove that air exists?" No response was received from the students. The teacher proceeded to instruct the students to fan their notebooks towards one

another or themselves, resembling a fan motion. The teacher then asked, "What happened?" Responses from the students indicated the presence of air or wind. When asked if air would be present in the classroom if it were empty, the students replied that air would not be present. The teacher concluded that since the classroom environment was not empty, there must have been something present. The teacher emphasized the notion that the classroom environment was not empty. Introducing a device related to sound propagation called an "air evacuation pump," the teacher familiarized the students with it. The air evacuation pump was a device within a plastic chamber that allowed the intake and release of air. The teacher played music from a phone and placed the phone inside the air evacuation pump. The teacher then asked the students if there was any change in the sound from the phone after a portion of the air inside the pump was removed. Responses from the students indicated that the sound from the phone became quiet with the removal of air from inside the pump. The teacher further reduced the air inside the pump and asked the students again about the change in the sound from the phone. Students indicated that the sound decreased further. The teacher wrote on the board, "As the air inside the chamber was removed, the sound decreased," and instructed the students to write the same. The teacher then asked the students if there was any change in the sound of the phone itself. The students said that there was no change in the sound of the phone itself. Despite no change in the sound of the phone itself, the teacher asked the students for their opinions on why they perceived the phone's sound to be inaudible. One student suggested it was not due to the phone but rather the chamber. Another student explained that sound was not heard in vacuums, and with the air evacuation pump removing air, sound became less audible. The teacher concluded that despite no change in the sound of the phone itself, the removal of air from the air evacuation pump resulted in decreased sound, highlighting the necessity of a material medium for sound propagation, which was reiterated on the board. The teacher then questioned the students about the situation of sound in space where there was no matter. Responses from the students included that there was no sound, it was not heard, and it did not propagate. The teacher asserted that in space where there was no matter or particles, sound did not propagate, and wrote the statement "Sound does not propagate in a vacuum" down on the board. The teacher previously removed some air from the air evacuation pump. Taking another step, the teacher ensured the restoration of the extracted air back into the chamber. After refilling the air inside the chamber, the teacher asked the students about the change in the sound of the phone. Students indicated that the sound increased. The teacher restated the necessity of a material medium for sound propagation and emphasized that sound did not propagate in a vacuum.

Interviews

Having participated in two classes described above, the students were invited to volunteer for an interview. Semi-structured interviews were carried out with a cohort of 20 students (10 female and 10 male) at the school library on December 14th and 15th, 2023. In the pilot studies, when students compare two classes, one is labeled "hands-on activity" and the other "non-hands-on," so when building interview questions, the class where the SDM is used is referred to as the class that students have named as the one with a hands-on activity. During the interviews, the teacher initially prompted students to compare the methods involving hands-on activities with those that did not, in terms of understandability and participation. Following this, the teacher inquired about the strengths and weaknesses of these methods, if any. At the end of the interviews, the teacher inquired which of these methods the students would prefer to see implemented in other classes. The student responses were elaborated through probing questions to obtain comprehensive and codable data. Below is the interview protocol.

Interview Protocol

1. Which method helped you learn better: the one where you discussed a hands-on activity or the one where you didn't? Why?
2. In which method were you more involved in class: the one with a hands-on activity or the one without? Why?
3. Concerning the hands-on activity, what did you like and dislike about it if any?
4. Concerning the method without the hands-on activity, what did you like and dislike about it if any?
5. Would you choose any of these methods to be used in other classes?

Operational Definitions for Codes

Each interview session was recorded and transcribed afterward. The transcriptions were then subjected to inductive analysis, following the approach outlined by Patton (2001), to identify recurring themes and patterns in the students' responses. Pseudonyms were assigned to the transcriptions to ensure the confidentiality of real names. Specifically, uppercase letter "S" was used to denote students, while uppercase "T" was utilized for the teacher's statements within the transcripts. Table 1 below displays the codes emerged from the data, their definitions, and sample student expressions associated with those codes.

Table 1
Operational Definitions and Sample Student Statements for Codes

Codes	**Code Descriptions**	**Sample Student Statements**
1.Comprehension	Statements where students indicate that they learn or understand better with the SDM.	*(I learned better in the experimental group)* S1
2. Retention	Statements where students indicate that what they learned with the SDM is more unforgettable.	(*You understand, you see, what you understand stays in your mind*) S3
3. Experience	Statements where students indicate that the SDM provides an opportunity for experiencing or observing the phenomenon.	*(Thanks to that pump, I saw how it was done, how it was done, …)* S4
4. Participation	Statements where students indicate that they participated more in the class given with the SDM.	*(… I participated more in the experimental group because there...)* S13
5. Enjoyment	Statements where students indicate that they found the SDM more enjoyable or liked the class given with this method.	*(...it's more fun in the experimental group...)* S7

The Results

Each student's explanations were analyzed based on Table 1 depicted above. Without exception, all students found the class conducted with the SDM to be superior in terms of comprehension, retention, experience, participation, and enjoyment. Table 2 below displays the codes that emerged from each student's explanations for the classroom where the SDM was in use.

Table 2
Data Analysis Table

Student	Gender	Codes emerged
1	Female	Comprehension, Experience, Participation, Enjoyment
2	Female	Comprehension, Experience, Participation
3	Male	Comprehension, Experience, Participation, Retention
4	Female	Comprehension, Experience, Participation, Enjoyment
5	Female	Comprehension, Experience, Participation
6	Male	Comprehension, Retention, Experience, Participation
7	Female	Comprehension, Retention, Experience, Participation
8	Female	Comprehension, Experience, Participation
9	Male	Comprehension, Experience, Participation
10	Female	Comprehension, Experience, Participation, Enjoyment
11	Male	Comprehension, Experience, Participation
12	Male	Comprehension, Experience, Participation
13	Male	Comprehension, Experience, Participation, Enjoyment
14	Male	Comprehension, Experience, Participation
15	Female	Comprehension, Experience, Participation
16	Male	Comprehension, Experience
17	Male	Comprehension, Retention, Experience, Participation
18	Male	Comprehension, Participation
19	Female	Comprehension, Participation
20	Female	Comprehension, Experience

To determine the reliability of the coding, two different fellows were asked to independently code the student statements. Then, the codes emerged from the data were compared with the researcher's own codes, and the percentage of agreement between the codes was calculated. The researchers' and coders' codes showed full consistency, 100 % agreement, indicating, according to Miles and Huberman (1994), which the coding was done with high reliability. To make the above data more comprehensible, the data has been converted into the following bar graph.

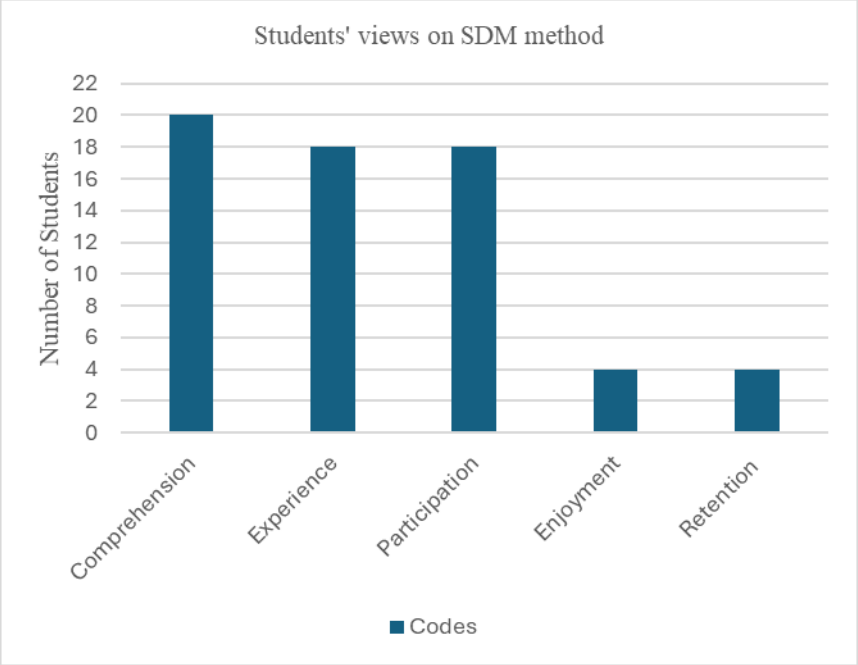

Figure 1. Students' views on SDM method

Figure 1 indicates that in the statements made by all 20 students, the "comprehension" code emerged, while in the statements of 18 students, the "experience" and "participation" codes emerged. Additionally, the "enjoyment" and the "retention" codes appeared in 4 student statements. In other words, all students specified that they learned better in the class where the SDM method was used. Further to that, 90% of the students mentioned that they had the opportunity to observe the phenomenon in the class where the SDM was used and stated that their participation in this class was higher. 20 % of the students found the class with the SDM more enjoyable and also expressed that what they learned in the class with the SDM was more unforgettable.

Conclusion and Discussion

The results indicated that all twenty students unanimously expressed their preference for the class where the Sociocultural Dialectic Method (SDM) was employed, citing its superiority in facilitating comprehension, fostering lasting learning experiences, promoting active participation, and enhancing overall enjoyment compared to the alternative method. Specifically, the "comprehension" code emerged consistently across all students' remarks, indicating a clear consensus regarding the effectiveness of the SDM approach in enhancing understanding. Moreover, eighteen students explicitly referenced the "experience" and "participation" codes in their statements, underscoring the immersive and engaging nature of the learning process facilitated by the SDM. In other words, a notable percentage of the students (90%) highlighted their enhanced observational opportunities and heightened engagement levels in the SDM classroom setting, affirming the method's efficacy in promoting active involvement and experiential learning. Additionally, a minority of students (20%) expressed their preference for the SDM class due to its perceived enjoyment factor, indicating a positive affective response to the learning environment. Similarly, a small fraction of students (20%) emphasized the superior retention of knowledge experienced in the SDM class, suggesting a tangible cognitive advantage associated with this instructional approach. In summary, the collective feedback from the students unequivocally underscores the advantages of the SDM in facilitating comprehensive learning experiences, fostering active participation, enhancing enjoyment, and

promoting long-term retention of knowledge, thereby affirming its superiority over an alternative instructional approach.

The outcome of this study aligns with a study conducted in 2021. In the previous study (Saglam & Goksu, 2021), it was observed that SDM led to an increase in students' behavioral, cognitive, and emotional engagement. Further to that, the data supporting the claim that students express enhanced learning in the SDM classroom has served as substantiating evidence for the assertion that meaning inherently emerges from its context (Bingolbali & Monaghan, 2007). Additionally, it supports the idea that learning is facilitated through an individual's active engagement in social and cultural activities within a specified setting (Vygotsky, 2016). Also, the assertion made by students regarding the improved learning experienced in the SDM class aligns with Van Oers' (2001) proposition that learning, being an abstraction, unfolds through social interactions within a particular context.

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Research Article
Received:28.09.2024
Accepted:30.12.2024
Published:31.12.2024

Citation: Kılınç, A., Kızmaz, S., Aksakal Taşkıran, Ş., & Emre, İ. (2024). Determination of teachers' awareness of environmental ethics. *International Journal of Scholars in Education*, *7*(2), 116-128. https://doi.org/10.52134/ueader.1557613

Determination of Teachers' Awareness of Environmental Ethics

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Abstract: Environmental ethics defines the moral principles governing the relationship between humans and their environment, emphasizing the need for harmony with nature. Raising awareness about environmental issues is believed to be achievable through education, with teachers playing a critical role in this process. This study aims to assess the level of environmental ethics awareness among teachers from various disciplines(classroom,science and social studies teachers) and examine whether variables such as gender, age, field, seniority, educational background, and academic status influence their opinions. The research employed a quantitative survey method, involving 346 teachers from public schools in Elazığ. Participants completed a personal data form and the Environmental Ethics Awareness Scale. The data were analyzed using the MANOVA test. Results indicated no significant differences across all sub-dimensions for teachers graduating from faculties outside the Faculty of Education. However, a significant difference was observed regarding the field variable, while other variables like gender, age, and seniority showed no significant differences. Arithmetic means of teachers' responses revealed that most opinions were at the "Agree" level across the sub-dimensions, except for specific items. These findings suggest that while teachers generally exhibit awareness of environmental ethics, their views vary depending on their field of expertise. This study highlights the importance of integrating environmental ethics into educational practices to further enhance teachers' awareness and their ability to address environmental issues effectively. Future research could expand on these findings by exploring other variables and methodologies to provide deeper insights into teachers' environmental ethics awareness.

Keywords: Environment, Environmental Ethics, Teacher.

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Introduction

Our planet's natural resources are being depleted, and many species are in danger of becoming extinct as a result of human attitudes toward the environment. The damage that people do to the environment has resulted in issues like climate change and global warming (Göz, 2011; Tozdan, 2022). At first, it was believed that the natural resources would never run out, but as the Industrial Revolution progressed, it became clear that they were fast running out, upsetting the ecological balance (Ergün & Çobanoğlu, 2012).

The emergence of environmental difficulties typically happened in the second half of the 20th century, and in this regard, the 1952 London air pollution incident that claimed over 4,000 lives is significant (Ertan, 2004). Despite the fact that several domestic and international agreements, conferences, and regulations have been signed, environmental issues have not significantly decreased as a result of these efforts; rather, they have become worse (Kırkpınar Özsoy & Çini, 2020).

Since its emergence as a distinct branch of philosophy in the 1970s, environmental ethics—which focuses on analyzing the moral dilemmas that arise in the interactions between humans and the non-human environment—has greatly broadened in scope (Palmer, McShane & Sandler, 2014). It is the study of the moral relationships that exist between people and other living things, as well as between people and their environmental surroundings. Establishing guidelines for people and their natural environments, accepting these guidelines as guiding principles, and promoting a positive outlook on environmental challenges are the goals of environmental ethics (Sandler, 2013). The systematic study of the moral connections between people and the environment, as well as the application of moral principles to regulate human behavior toward the natural world, are the broad definitions of environmental ethics (Sönmez, 2019). Therefore, environmental ethics include educating people about the appropriate behaviors to display, the obligations to fulfill in accordance with these regulations, and the possible repercussions of the attitudes they embrace (Öğüt Ebil &İdemen, 2010).

The degree of consciousness people have about environmental ethics is referred to as environmental ethics awareness (Buzlukçu, 2023). The three main categories of environmental ethics methods are ecocentric, biocentric, and anthropocentric (Kayaer, 2013). Since people are at the center of the world, everything that exists must be assessed according to how useful it is to us, according to the anthropocentric (human-centered) approach, which is regarded as a conventional ethical stance (Laal, 2009). However, environmental ethics clarifies the obligations that humans have while also explaining that respect should be shown to living things other than humans and that nature should be assessed in a variety of ways (Sönmez, 2017).

Teachers are one of the most important components of environmental education. Teachers help people develop positive attitudes and actions by imparting knowledge to them. Thus, it is important to start by looking at the attitudes and actions of educators (Çiller, 2023). Teacher candidates across a range of disciplines are the primary subject of studies on environmental ethics and awareness (Saka, 2016; Deniz, 2019; Sönmez, 2019). There are comparatively few studies that involve instructors, and those that do exist are frequently restricted to one or two branches (Duru & Bakanay, 2021). Additionally, there aren't many studies like this one that include social studies, science, and classroom teachers. Consequently, it is thought that this study will add to the body of knowledge, especially with regard to teaching disciplines. It is acknowledged that people's lack of awareness about environmental issues is the main cause of environmental problems, and in this regard, education in schools is said to be essential for resolving environmental issues and increasing awareness (Altın & Akcanca, 2023).

It is also far simpler to educate environmentally conscientious people under the direction of instructors who function as role models, given the influence that educators have on their students. As a result, educators have a big role to play in fostering environmental awareness and building the cognitive skills necessary to address environmental challenges. Thus, it is thought that research on teachers' perspectives on environmental concerns advances the discipline (Duru & Bakanay, 2021; Tekiroğlu & Hayır Kanat, 2021).

Finding out how knowledgeable instructors from various areas are of environmental ethics is the main goal of this study. The following research questions were sought in order to achieve this goal:

1. How much do instructors know about environmental ethics?
2. Do branch characteristics, gender, seniority, education level, age, and the school from which a teacher graduated significantly affect their understanding of environmental ethics?

Methodology

Model of the Research

This study was carried out utilizing the survey technique in order to ascertain the environmental ethical awareness levels of primary and secondary school teachers based on a number of criteria. This approach seeks to depict a scenario, either historical or present, as it is at the moment. The objective is to portray the situation as it is and in a way that is appropriate for its particular circumstances (Karasar, 2010).

Population and Sample

Teachers of social studies, science, and classroom instruction at Turkey's public schools make up the study's general population. Classroom and subject teachers from elementary and high schools in Elazığ province during the 2023–2024 school year make up the study's sample. One of the sampling strategies used in quantitative research, the simple random sampling approach, was used to choose the sample. According to Cohen, Manion, and Morrison (2007), random sampling is a technique where every member of the population has an equal and independent probability of being included in the sample.

The research involved 346 instructors in all. The following tables include descriptive information about the sample's demographic characteristics:

Table 1
Distribution by branch variable

Branch	n	%
Classroom Teacher	213	61.6
Science Teacher	79	22.8
Social Studies Teacher	54	15.6
Total	346	100

Of the instructors who took part in the study, 79 (22.8%) were science teachers, 54 (15.6%) were social studies teachers, and 213 (61.6%) were elementary school teachers.

Table 2
Distribution by gender

Gender	n	%
Female	164	47.4
Male	182	52.6
Total	346	100

182 (52.6%) of the participants who took part in the survey were male, and 164 (47.4%) were female.

Table 3
Distribution by seniority

Seniority	n	%
1-10 years	33	9.5
11-20 years	107	30.9
21 -30 years	173	50.0
31 years and above	33	9.5
Total	346	100

Of the research participants, 33 (9.5%) had one to ten years of seniority, 107 (30.9%) had eleven to twenty years, 173 (50.0%) had twenty to thirty years, and 33 (9.5%) had thirty-one years or more.

Table 4
Distribution by school graduated from

School Graduated From	n	%
Faculty of Education	225	65.0
Other	121	35.0
Total	346	100

A total of 121 (35.0%) of the instructors who took part in the study are graduates of different faculties, and 225 (65.0%) are graduates of the Faculty of Education.

Table 5
Distribution by educational level

Educational Level	n	%
Bachelor’s degree	266	76.9
Graduate degree	80	23.1
Total	346	100

Two hundred and sixty-six (76.9%) of the study's participating instructors hold a bachelor's degree, and eighty (23.1%) hold a graduate degree.

Table 6
Distribution by age

Age range	n	%
22-32 years	37	10.7
33-43 years	117	33.8
44-54 years	154	44.5
55 years and above	38	11.0
Total	346	100

37 (10.7%) of the study's participating instructors are between the ages of 22 and 32, 117 (33.8%) are between the ages of 33 and 43, 154 (44.5%) are between the ages of 44 and 54, and 38 (11.0%) are 55 years of age or older.

Data Collection Tools

Personal Data Form

The study employed a personal data form to gather demographic data from the participating instructors. Variables including gender, age, branch, seniority, school attended, and educational attainment are all included in the form.

Environmental Ethics Awareness Scale

The four sub-dimensions of the scale created by Özer and Keleş (2016) are the definition of environmental ethics, its goal, the causes of its creation, and the appropriate actions. Using a 5-point Likert scale (Strongly Disagree to Strongly Agree), the measure has 23 items. The scale's Cronbach alpha reliability coefficient was 0.95, and the confirmatory factor analysis's findings were consistent with previous research. The scale's reliability coefficient in this investigation was 0.99.

Data Collection Process

After receiving clearance from the Ethics Committee and authorization from the Elazığ Provincial Directorate of National Education, the study's data were gathered during the autumn semester of the 2023–2024 academic year. Teachers who chose to participate were asked to complete the scale and the personal data form, and the instructions made clear the goal of the study.

Data Analysis

Percentage and frequency analyses were performed to examine the opinions of classroom teachers, science teachers, and social studies teachers on the Environmental Ethics Awareness Scale's sub-dimensions as well as individual data. MANOVA tests were used once the data's normality distribution was examined. The Scheffe post-hoc test was employed when significant differences between groups were discovered. Sample size, outliers, normality, homogeneity of regression, linearity, multicollinearity, singularity, and homogeneity of variance and covariance matrices were all found to be free of significant violations for the MANOVA test analysis. The statistical program SPSS was used to analyze the data. The results of the necessary studies to ascertain the normality distribution showed that the data was distributed normally.

Findings

Descriptive Statistics

The findings of the study done to ascertain the normalcy distribution are shown in Table 7.

The findings show that the data is distributed normally. For the scale and its subdimensions, the significant values derived from the Shapiro-Wilk and Kolmogorov-Smirnov tests were $p < .05$. The probability of Kolmogorov-Smirnov test findings being less than.05 has been seen to rise in the social sciences, especially when the sample size is big (Balcı & Ahi, 2017). Nonetheless, the results are deemed sufficiently robust when the sample size in each cell

surpasses 20 (Tabachnick & Fidell, 2007). This research also looked at other facts that were pertinent to normalcy.

Table 7
Descriptive Statistics

Scales/Subdimensions	Mean	Trimmed Mean	Min.	Max.	Mode	Median	Kurtosis	Standard Error of Kurtosis	Skewness	Standard Error of Skewness	Kolmogorov-Smirnov	Shapiro-Wilk
Environmental Ethics Definition	24.60	25.01	7.00	35.00	35.00	32.50	-1.563	.260	-.596	.131	.000	.000
Environmental Ethics Purpose	10.69	10.88	3.00	15.00	15.00	15.00	-1.563	.260	-.606	.131	.000	.000
Environmental Ethics Reason	17.56	17.84	5.00	25.00	25.00	22.00	-1.478	.260	-.592	.131	.000	.000
Environmental Ethics Measure	27.72	28.13	8.00	40.00	40.00	35.00	-1.481	.260	-.591	.131	.000	.000
Environmental Ethics Awareness Scale (Total Scale)	80.58	81.87	23.00	115.00	105.00	115.00	-1.539	.260	-.608	.131	.000	.000

The kurtosis and skewness values, which are regarded as markers of a normal distribution, were determined to fall between -1.96 and +1.96, and their corresponding standard error values were 0.133 and 0.266 (Uysal & Kılıç, 2022). Additionally, the MANOVA assumptions were examined as well, and it was found that they were frequently satisfied.

Table 8
Results of the multivariate variance analysis of the environmental ethics awareness scale based on gender

Effect	Wilk's Lambda	F	Hypothesis sd	Error sd	p	Partial Eta Squared	Observed Power
Intercept	.148	492.139	4.00	341.00	.000	.852	1.00
Group	.989	.961	4.00	341.00	.824	.011	.304

Table 9
Between-group effects for subdimension scores of the environmental ethics awareness scale based on gender

Source	Dependent Variable	df	F	p*	Partial Eta Squared	Observed Power
Intercept	Environmental Ethics Definition	1	1362.408	.000	.798	1.000
	Environmental Ethics Purpose	1	1335.762	.000	.795	1.000
	Environmental Ethics Reason	1	1569.573	.000	.820	1.000
	Environmental Ethics Measure	1	1604.501	.000	.823	1.000
Gender	Environmental Ethics Definition	1	.050	.824	.000	.056
	Environmental Ethics Purpose	1	.037	.847	.000	.054
	Environmental Ethics Reason	1	.019	.890	.000	.052
	Environmental Ethics Measure	1	.016	.900	.000	.052

*p > .05

Male and female instructors do not significantly vary in any of the subdimensions when the gender variable data are analyzed (p>.05).

Table 10
Results of the multivariate variance analysis of the environmental ethics awareness scale based on seniority

Effect	Wilk's Lambda	F	Hypothesis sd	Error sd	p	Partial Eta Squared	Observed Power
Intercept	.217	301.658	4.00	339.00	.000	.783	1.00
Group	.986	.388	12.00	897.201	.968	.005	.201

Table 11
Between-group effects for subdimension scores of the environmental ethics awareness scale based on seniority

Source	Dependent Variable	df	F	p*	Partial Eta Squared	Observed Power
Intercept	Environmental Ethics Definition	1	865.152	.000	.717	1.00
	Environmental Ethics Purpose	1	852.787	.000	.714	1.00
	Environmental Ethics Reason	1	997.016	.000	.745	1.00
	Environmental Ethics Measure	1	1014.658	.000	.748	1.00
Seniority	Environmental Ethics Definition	1	.382	.766	.003	.125
	Environmental Ethics Purpose	1	.494	.687	.004	.150
	Environmental Ethics Reason	1	.451	.717	.004	.141
	Environmental Ethics Measure	1	.343	.795	.003	.117

*p>.05

Evaluation of the seniority variable findings reveals that none of the subdimensions show a significant difference between groups (p>.05).

Table 12
Results of the multivariate variance analysis of the environmental ethics awareness scale based on graduation school

Effect	Wilk's Lambda	F	Hypothesis sd	Error sd	p	Partial Eta Squared	Observed Power
Intercept	.153	471.219	4.00	341.00	.000	.847	1.00
Group	.964	3.188	4.00	341.00	.014	.036	.823

Table 13
Between-group effects for subdimension scores of the environmental ethics awareness scale based on graduation school

Source	Dependent Variable	df	F	p*	Partial Eta Squared	Observed Power
Intercept	Environmental Ethics Definition	1	1326.516	.000	.794	1.00
	Environmental Ethics Purpose	1	1314.763	.000	.793	1.00
	Environmental Ethics Reason	1	1533.170	.000	.817	1.00
	Environmental Ethics Measure	1	1566.653	.000	.820	1.00
Graduation School	Environmental Ethics Definition	1	7.083	.008	.020	.756
	Environmental Ethics Purpose	1	8.912	.003	.025	.845
	Environmental Ethics Reason	1	8.366	.004	.024	.822
	Environmental Ethics Measure	1	8.278	.004	.023	.818

*p<.05

For the graduation school variable, there is a significant difference (p<.05) across all subdimensions favoring the group graduating from non-education faculties.

Table 14
Results of the multivariate variance analysis of the environmental ethics awareness scale based on the education level variable

Effect	Wilk's Lambda	F	Hypothesis sd	Error sd	p	Partial Eta Squared	Observed Power
Intercept	.200	341.256	4.00	341.00	.000	.800	1.00
Group	.970	2.648	4.00	341.00	.033	.030	.737

Table 15
Between-group effects for subdimension scores of the environmental ethics awareness scale based on education level

Source	Dependent Variable	df	F	p*	Partial Eta Squared	Observed Power
Intercept	Environmental Ethics Definition	1	984.252	.000	.741	1.00
	Environmental Ethics Purpose	1	972.001	.000	.739	1.00
	Environmental Ethics Reason	1	1131.162	.000	.767	1.00
	Environmental Ethics Measure	1	1143.151	.000	.769	1.00
Education Level	Environmental Ethics Definition	1	.129	.719	.000	.065
	Environmental Ethics Purpose	1	.305	.581	.001	.085
	Environmental Ethics Reason	1	.115	.737	.000	.063
	Environmental Ethics Measure	1	.001	.976	.000	.050

*p>.05

There is no discernible difference between groups in any of the subdimensions when the findings for the education level variable are analyzed (p>.05).

Table 16
Results of the multivariate variance analysis of the environmental ethics awareness scale based on the age variable

Effect	Wilk's Lambda	F	Hypothesis sd	Error sd	p	Partial Eta Squared	Observed Power
Intercept	.207	324.867	4.00	339.00	.000	.793	1.00
Group	.963	1.070	12.00	897.201	.382	.012	.563

Table 17
Between-group effects for subdimension scores of the environmental ethics awareness scale based on age

Source	Dependent Variable	df	F	p*	Partial Eta Squared	Observed Power
Intercept	Environmental Ethics Definition	1	909.450	.000	.727	1.00
	Environmental Ethics Purpose	1	894.211	.000	.723	1.00
	Environmental Ethics Reason	1	1041.774	.000	.753	1.00
	Environmental Ethics Measure	1	1074.067	.000	.758	1.00
Age	Environmental Ethics Definition	3	1.838	.140	.016	.476
	Environmental Ethics Purpose	3	1.785	.150	.015	.464
	Environmental Ethics Reason	3	1.915	.127	.017	.494
	Environmental Ethics Measure	3	2.180	.090	.019	.552

*p>.05

There is no discernible difference between groups in any of the subdimensions when the age variable findings are analyzed (p>.05).

Table 18
Results of the multivariate variance analysis of the environmental ethics awareness scale based on the field variable

Effect	Wilk's Lambda	F	Hypothesis sd	Error sd	p	Partial Eta Squared	Observed Power
Intercept	.125	595.123	4.00	340.00	.000	.875	1.00
Group	.643	21.016	8.00	680.00	.000	.198	1.00

Table 19
Between-group effects for subdimension scores of the environmental ethics awareness scale based on branch

Source	Dependent Variable	df	F	p*	Partial Eta Squared	Observed Power
Intercept	Environmental Ethics Definition	1	1900.333	.000	.847	1.00
	Environmental Ethics Purpose	1	1921.193	.000	.849	1.00
	Environmental Ethics Reason	1	2233.346	.000	.867	1.00
	Environmental Ethics Measure	1	2129.497	.000	.861	1.00
Branch	Environmental Ethics Definition	2	74.42	.000	.303	1.00
	Environmental Ethics Purpose	2	79.98	.000	.313	1.00
	Environmental Ethics Reason	2	81.66	.000	.323	1.00
	Environmental Ethics Measure	2	68.83	.000	.286	1.00

*p<.05

Upon evaluating the data using the branch variable, it is found that all subdimensions show a significant difference between groups (p <.05). There was a substantial difference between classroom teachers and both science and social studies teachers across all subdimensions, according to the findings of the Scheffee test, one of the post hoc tests. But there was no discernible difference between social studies and science teachers.

When the arithmetic means of the groups for each subdimension are examined:

- In the first subdimension, Definition, the arithmetic mean of Classroom Teachers was $\bar{X}$=19.23, while the mean of Science Teachers was $\bar{X}$=33.50, and that of Social Studies Teachers was $\bar{X}$=32.72

- In the second subdimension, Purpose, the arithmetic mean of Classroom Teachers was $\bar{X}$=8.28, while the mean of Science Teachers was $\bar{X}$=14.74, and that of Social Studies Teachers was $\bar{X}$=14.27.

- In the third subdimension, Reason, the arithmetic mean of Classroom Teachers was $\bar{X}$=13.87, while the mean of Science Teachers was $\bar{X}$=23.55, and that of Social Studies Teachers was $\bar{X}$=23.33.

- In the fourth subdimension, Measure, the arithmetic mean of Classroom Teachers was $\bar{X}$=22.30, while the mean of Science Teachers was $\bar{X}$=36.54, and that of Social Studies Teachers was $\bar{X}$=36.20.

These findings indicate significant differences in arithmetic means across the branches for all subdimensions.

Conclusion, Discussion, and Recommendations

It is underlined that in order to create a culture of environmental ethics, educators must first be very conscientious, and that society consciousness may foster environmental ethics in people. Environmental ethics are typically viewed by educators as a collection of regulations (Taşçı, 2023). Additionally, it is mentioned that society and educators are crucial in creating value-based curricula that guarantee pupils appreciate the environment throughout their life (Somashekara & Praveena, 2023). Depending on their level of understanding, people's beliefs have a big impact on emerging environmental challenges such waste management methods (Cavaliere et al., 2020).

Upon reviewing the instructors' answers to the scale, it was discovered that they agreed with the Definition of Environmental Ethics subdimension's items at the "Agree" level.

The items "If humans lived a life without technology, they would better understand the value of both living and non-living things" and "To ensure human welfare, people's negative behaviors towards the environment must be limited" were rated as "Neutral" by teachers in the Measures to be Taken for Environmental Ethics subdimension. Responses were at the "Agree" level for the remaining items in this subdimension. The items in the subdimensions of the Reasons for the Emergence of Environmental Ethics and the Objectives of Environmental Ethics were also rated as "Agree" by participants.

Tekiroğlu and Hayır-Kanat's (2021) study of Social Studies teachers revealed that their scores on the scale's subdimensions were nearly equal to the maximum score, suggesting that they were highly aware of the definition, emergence reasons, goals, and countermeasures for environmental issues pertaining to environmental ethics. According to Anokye et al. (2024), instructors were probably very conscious of the surroundings.

Upon analyzing the study's overall findings, no discernible variations were found between the groups according to age, seniority, gender, or educational attainment. Karakaya and Yılmaz (2017) observed no significant differences in seniority or educational level, however they did find a significant variation in the gender variable between science and biology professors. Tekiroğlu and Hayır-Kanat's (2021) study of social studies teachers also found no differences in environmental ethics awareness by gender, length of service, or involvement in environmental in-service training. Environmental ethics awareness varied significantly by gender but not by department, according to Sönmez's (2019) study of Science and Classroom teacher candidates. Similar findings were made by Somashekara and Praveena in their 2023 study of classroom teachers, which did not reveal any gender-based changes.

There are no notable gender differences in environmental concerns, despite some study suggesting that women are more sensitive to environmental issues than males (Zelezny et al., 2000; Hunter et al., 2004; Saka, Sürmeli & Öztuna, 2013). In contrast, Macdonald and Hara's (1994) study found that men were more concerned about the environment than women. Significant differences were found across all subdimensions in favor of groups comprising graduates from faculties other than education faculties with regard to the variable of educational background. This might be the case because educators in disciplines that have a direct bearing on the environment, like biology and chemistry, receive more academic training on environmental issues and, as a result, are more conscious of environmental ethics.

There were notable variations between the groups in every subdimension when the findings were analyzed using the branch variable. Classroom teachers differed significantly from both science and social studies teachers in every subdimension. Nonetheless, no noteworthy distinctions between teachers of social studies and science were discovered. In the

subdimensions of Reasons for the Emergence of Environmental Ethics and Measures to be Taken for Environmental Ethics, their arithmetic means were especially similar.

With several items demonstrating notable variances based on gender, branch, and professional experience, Ceyhan and Şahin's (2018) study also revealed that teachers of science and classrooms demonstrated a high level of ethical sensitivity towards technology and environmental challenges. According to Anokye et al. (2024), teachers' opinions and comprehension of environmental problems are greatly influenced by their educational background. The researchers also observed that people's views on the environment, including waste management, are influenced by their specialized knowledge and academic accomplishments (Anokye, 2024).

The research's conclusions allow for the following suggestions to be made:

1. Future research could be organized utilizing mixed or qualitative research approaches to better interpret the findings of this quantitative study.

2. Teachers from various branches can participate in comparative research.

3. It is possible to do experimental research on environmental ethics awareness.

4. By taking into account characteristics other than those employed in this study, similar research can be carried out.

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Research Article
Received: 14.11.2024
Accepted: 30.12.2024
Published 31.12.2024:

Citation: Yılmaz, N., Alkan, Z., Şahin, M., Gürbüz, T., & Akbucak, İ. (2024). The effect of student-centred teaching on academic achievement in religious culture and moral knowledge education. *International Journal of Scholars in Education*, *7*(2), 129-137. https://doi.org/10.52134/ueader.1585408

Din Kültürü ve Ahlak Bilgisi Öğretiminde Öğrenci Merkezli Öğretimin Akademik Başarı Üzerindeki Etkisi

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Öz: Bu araştırmada din kültürü ve ahlak bilgisi öğretiminde öğrenci merkezli öğretimin öğrencilerin akademik başarıları üzerindeki etkisi ortaya konulmaya çalışılmıştır. Bu nedenle çalışmada nicel araştırma yaklaşımlarından meta analiz yöntemi benimsenmiştir. Çalışma kapsamında Yükseköğretim Kurumu tez merkezinde tarama yapılmış, dahil olma kriterlerini karşılayan 16 çalışma araştırmaya alınmıştır. Çalışmalarda yayın yanlılığı bulunup bulunmadığına karar vermek için Rosenthal ve huni grafik tekniklerinden yararlanılmıştır. İki yönteme göre de çalışma kapsamına alınan araştırmaların yayın yanlılığından uzak olduğu görülmüştür. Analizlerde öncelikle 16 bağımsız araştırmadan 20 bağımsız etki değeri türetilmiş ve her bir öğrenci merkezli öğretim uygulaması bağımsız olarak yorumlanmıştır. Çalışmanın devamında ise bu çalışmaların birleştirilmiş etki değeri hesaplanmıştır. Birleştirilmiş etki değerinin yorumlanmasında rastgele etkiler modelinden yararlanılmıştır. Çalışmaların birleştirilmiş etki değeri 0.969 olarak hesaplanmıştır. Bu kapsamda çalışmada elde edilen bulgulara göre din kültürü ve ahlak bilgisi öğretiminde öğrenci merkezli öğretim uygulamalarının öğrencilerin akademik başarıları üzerinde geniş bir etkisi olduğu sonucuna ulaşılmıştır.
Anahtar Sözcükler: Öğrenci merkezli öğretim, din kültürü ve ahlak bilgisi, akademik başarı, meta-analiz.

The Effect of Student-Centered Teaching on Academic Achievement in Religious Culture and Moral Knowledge Education

Abstract: In this study, the effect of student-centered teaching on students' academic achievement in religious culture and moral knowledge teaching was tried to be revealed. For this reason, meta-analysis method, one of the quantitative research approaches, was adopted in the study. Within the scope of the study, a search was made in the thesis center of the Higher Education Institution and 16 studies that met the inclusion criteria were included in the study. Rosenthal and funnel graph techniques were used to decide whether there was publication bias in the studies. According to both methods, it was seen that the studies included in the study were free from publication bias. In the analyses, firstly, 20 independent effect values were derived from 16 independent studies and each student-centered teaching practice was interpreted independently. In the continuation of the study, the combined effect value of these studies was calculated. Random effects model was used in the interpretation of the combined effect value. The combined effect value of the studies was calculated as 0.969. In this context, according to the findings obtained in the study, it was concluded that student-centered teaching practices in religious culture and ethics teaching have a wide effect on students' academic achievement.
Keywords: Student-centered teaching, religious culture and ethics, academic achievement, meta-analysis.

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Introduction

The teaching of Religious Culture and Moral Knowledge begins in the 4th grade of primary school, and its fundamental aim is to instill religious knowledge, skills, values, and ethics. Given the individual and societal significance of religious education, it can be stated that it is a sensitive value that should not be left to informal environments (Burak, 2017). Similar to many countries, religious education in Turkey is conducted within the framework of specific curriculum programs in schools. Consequently, religious education occurs through a teaching process designed by teachers in accordance with these programs, during which teachers benefit from various methods, techniques, and materials. The teacher's primary responsibility in the teaching process is defined as creating effective and efficient learning environments (Erden and Akman, 2001). Based on this premise, it can be asserted that it is critical for teachers to identify and utilize the most effective methods, techniques, and materials to meet the objectives of the course in religious education.

Currently, the curriculum updated in 2018 is utilized for the teaching of Religious Culture and Moral Knowledge. The curriculum emphasizes that the fundamental teaching approach is centered around constructivism, skill-based learning, and multiple intelligences, highlighting a student-centered framework (Ministry of National Education, MoNE, 2018). Therefore, teachers need to move beyond traditional teaching approaches in religious culture and moral knowledge education and adopt teaching methods that focus on the student. In this context, Baeten, Struyven, and Dochy (2013) describe student-centered teaching through three key features: (1) ensuring active participation of students to construct knowledge, (2) the teacher guiding and directing the learning process, and (3) facilitating socialization and presenting real problem situations. Thus, student-centered learning or teaching is supported by social constructivism (Yaşar et al., 2015). It can be stated that in religious culture and moral knowledge education, a student-centered teaching approach can be achieved through the use of various methods that allow students to take responsibility, actively participate, learn by doing and experiencing, and interact.

There are numerous methods and techniques that center on students. These approaches are alternatives to the traditional model, where the teacher is the focal point and the student remains a passive recipient. Therefore, collaborative learning, project-based learning, problem-based learning, multiple intelligence learning, drama, differentiated learning, active learning, experiments, and discovery learning, among others, inherently aim to engage students and place them at the center (Kurt et al., 2024). In this context, teachers of religious culture and moral knowledge can utilize a wide array of methods and techniques to provide student-centered teaching. However, the extent to which these student-centered methods and techniques effectively and efficiently deliver instruction remains a matter of inquiry. The literature indicates that student-centered teaching has a significant impact on students' academic success and attitudes toward classes across various disciplines. For instance, Kurt et al. (2024) reported on academic success in life sciences education, Yaşar et al. (2015) in social studies education, Çelik (2024) in Turkish language education regarding listening comprehension, and Uyandıran and Tarım (2024) in mathematics education concerning problem-solving skills, while Yağan (2022) reported that student-centered teaching positively impacts attitude in the overall teaching process.

Although studies exist that demonstrate the effects of student-centered teaching on academic success, attitudes, reading comprehension, and problem-solving skills in different teaching fields, research on the effects of student-centered teaching on academic success specifically in religious culture and moral knowledge education is limited. Given that the subject matter of Religious Culture and Moral Knowledge education is based on abstract concepts, there is a need for studies that concretize the lessons through methods and techniques

centered on students. Furthermore, academic success is considered a tangible measure of how effectively teaching objectives are reached within an educational process (Burak and Gültekin, 2022). Therefore, focusing on academic success is important for the concrete examination and interpretation of the methods and techniques used in the teaching of religious culture and moral knowledge, which is evaluated on an abstract basis. In this context, this study aims to highlight the impact of student-centered teaching on students' academic success in Religious Culture and Moral Knowledge education. Accordingly, the study seeks to answer the question: "What is the impact of student-centered teaching on academic success in Religious Culture and Moral Knowledge education?" It is expected that the study will contribute to the field of religious culture and moral knowledge teaching and to the teachers involved.

Method

This study aims to determine the overall impact of student-centered teaching methods on academic achievement in the teaching of Religious Culture and Moral Knowledge. In this respect, the studies in the literature that have tested the effects of teaching methods outside traditional approaches within the scope of Religious Culture and Moral Knowledge education constitute the subject of this research. Therefore, the study focuses on experimental studies where student-centered teaching methods are the independent variable, while academic achievement and attitudes are the dependent variables. This research is designed as a meta-analysis study centered on this focus. Meta-analysis studies are works that combine and summarize the results of different studies within the same focus (Karadavut, 2022; Topkaya et al., 2023). As such, meta-analysis studies are secondary research where a large number of studies are systematically examined and summarized (Glass, 1976).

Meta-analysis research is conducted through a three-stage approach: (i) conducting a literature review and neutrally selecting appropriate studies based on research aims and questions, (ii) coding the selected studies and determining the effect size for each study, and (iii) calculating and interpreting the overall effect size of the studies (Dinçer, 2014). Accordingly, in this study, the literature was reviewed for experimental research that tested the effects of methods outside traditional teaching in the context of Religious Culture and Moral Knowledge education. The studies in the literature were examined and coded methodologically (sample size, data collection process, data analysis techniques, etc.), and subsequently, statistical interpretations of the findings were analyzed (arithmetic mean, standard deviation, t-value, p-value, etc.). In the final stage, the effect sizes of the examined studies were calculated using statistical techniques.

Data Collection Process

The focus of this study is on graduate theses scanned in the National Thesis Center of the Higher Education Council (HEC). In line with the study's purpose, some graduate theses were included in the meta-analysis. Therefore, inclusion criteria were applied in the selection of studies, and those not meeting the criteria were excluded from the research. The inclusion criteria used for study selection are as follows:

- The study must have been conducted within the context of Religious Culture and Moral Knowledge education,
- There must be open access permission, and the study should have been conducted within the last 20 years,
- The study must use an experimental model,
- The study must include both experimental and control groups,

- Data must be obtained using pre-tests and post-tests

The search for studies according to the relevant criteria was conducted between 12.09.2024 and 31.10.2024. During the screening conducted in the thesis center, the keywords “Din kültürü ve Ahlak Bilgisi,” “Religious Culture and Ethical Knowledge,” “Religious Culture and Moral Knowledge,” “Akademik Başarı,” “Academic Achievement,” and “Academic Success” were used, resulting in 349 studies. Following the examination based on the inclusion criteria, 16 studies were included in the research. These studies were coded primarily using a form, where the coding process involved the author, year, sample size, participant characteristics, the methods used in the experimental study, and statistical findings.

Data Analysis

In this study, 20 effect sizes were determined from the 16 studies. Hedge’s g was used to calculate the effect sizes, while the interval criteria suggested by Thalheimer and Cook (2002) for “g” effect size calculations within level classification were taken into account:

-0.15 to 0.15: insignificant level
-0.15 to 0.40: small level
-0.40 to 0.75: moderate level
-+0.75 to 1.10: large level
-1.10 to 1.45: very large level

Two different models are recommended for interpreting effect sizes in meta-analysis (Batdı, 2014; Üstün and Eryılmaz, 2014). The first model is the fixed effects model (FEM), and the second is the random effects model (REM). Due to the very limited conditions under which SEM is suitable, the multitude of its assumptions, and the difficulty in ensuring homogeneity (Schmidt et al., 2009), the REM model was preferred for this study. The Comprehensive Meta Analysis (CMA) software package was used for analyzing the data of this research.

Publications Bias

One of the most significant limitations of meta-analysis studies is the presence of publication bias (Üstün and Eryılmaz, 2014). The existence of publication bias can reduce the validity and reliability of study results and may lead to erroneous conclusions. In this context, the Rosenthal method was employed in the current study to determine whether there is a publication bias problem, and a funnel plot analysis was conducted. The Rosenthal method involves estimating how many counter studies would need to be conducted to bring the effect size obtained from the analyses to a value of "0" (zero) (Burak, 2023; Özcan, 2008). In this study, 20 effect sizes were derived from 16 studies. According to the Rosenthal method, in order to assert that the effect sizes reached in this study are biased, there would need to be 1201 opposing studies related to academic achievement. Therefore, it can be stated that the effect sizes obtained in the current study do not indicate publication bias.

To determine the presence of publication bias, the funnel plot technique was also utilized in this study. The funnel plot presents the distribution of the effect sizes of each independent study around the overall effect size. The scattering of independent studies within the funnel in the graph and its symmetry indicates that there is no publication bias (Dinçer, 2014). Figure 1 presents the funnel plot of the current study.

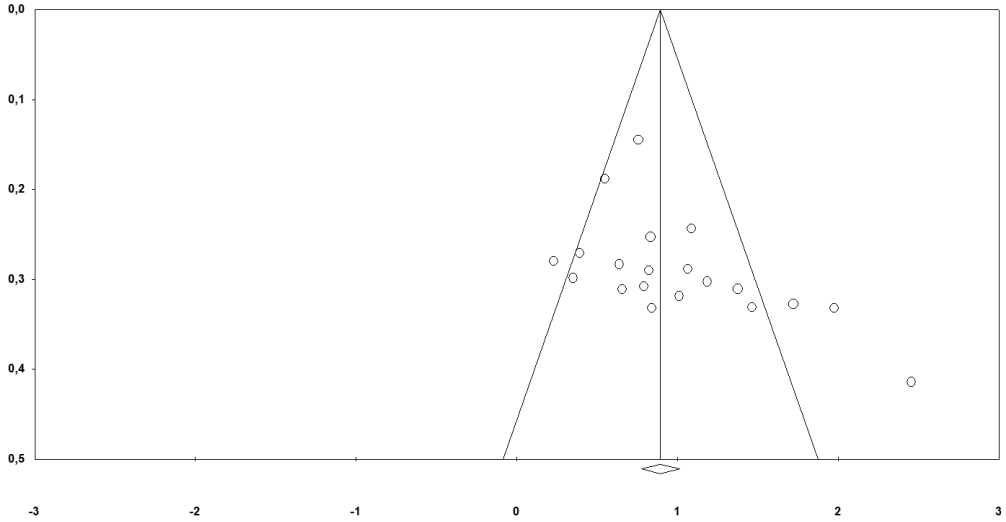

Figure 1. The Funnel Plot

According to the funnel plot in Figure 1, the independent effect values of each study were generally scattered within the funnel. Based on this, it can be said that there is no publication bias in the current study.

Results

In the present study, in order to find an answer to the research question 'What is the effect of student-centred teaching on academic achievement in religious culture and moral knowledge teaching', firstly the independent effect size of each study was calculated and then the general effect size was determined and interpreted. In this context, the findings of 20 independent effect sizes and confidence intervals and study weights obtained from 16 experimental studies in which the effect of student-centred teaching on academic achievement in religious culture and ethics teaching was tested are given in Table 1.

Table 1
Independent Effect Values of Studies Related to Academic Achievement

Studies	The methods of the student-centred teaching	Effect size	Confidence interval		Study Weights (FEM)	Study Weights (REM)
			Lower	Upper		
Orhan, 2024	Peer Teaching	0.835	0.339	1.330	5.66	5.48
Yörük, 2007	Multiple Intelligences	1.378	0.769	1.987	3.75	4.74
Çeken, 2024	Educational Game	0.351	-0.234	0.937	4.06	4.89
Nursel, 2017	Educational Game	1.089	0.612	1.567	6.09	5.39
Ekinci, 2020	Informal Learning	0.549	0.180	0.918	10.21	6.33
Türker, 2024	Educational Game	2.458	1.646	3.027	2.11	3.63
Erim, 2019	Problem Based Learning	0.640	0.084	1.195	4.50	5.08
Özcan, 2021**	Flipped Learning	0.759	0.475	1.045	17.38	6.46
Özcan, 2021*	Flipped Learning	0.231	-0.317	0.779	4.52	5.43
Özcan, 2021*	Flipped Learning	1.465	0.816	2.144	3.30	4.50
Özcan, 2021*	Flipped Learning	1.066	0.500	1.631	4.34	5.01
Özcan, 2021*	Flipped Learning	0.394	-0.137	0.935	4.92	5.24
Demir, 2016	Brain Based Teaching.	1.979	1.326	2.627	3.28	4.49
Çelik, 2016	Mind Map	1.188	0.595	1.781	3.95	4.84
Kazancı, 2019	Biography	1.013	0.388	1.637	3.56	4.65

Kaya, 2013*	Multiple Intelligences	0.791	0.187	1.394	3.81	4.78
Kaya, 2013*	Multiple Intelligences	0.841	0.191	1.492	3.28	4.49
Kaya, 2013*	Multiple Intelligences	0.657	0.047	1.267	3.73	4.74
Yörük, 2007*	Multiple Intelligences	0.822	0.253	1.391	4.29	4.99
Yörük, 2007*	Multiple Intelligences	1.722	1.081	2.164	3.37	4.54

**Studies were repeated in different samples. **Different samples were combined in the study.*

In Table 1, 20 effect values produced from 16 different studies, lower and upper limits of these values and study weights according to different models are given. According to Table 1, the independent effect values of the studies took values between 0.231 and 2.458. Therefore, it is understood that each study independently has an effect that will create a positive effect size. Accordingly, it can be said that the academic achievement scores in the experimental studies in which the effect of student-centred teaching on academic achievement in religious culture and moral knowledge teaching was tested differed significantly in favour of the experimental groups. In other words, it can be stated that student-centred teaching in religious culture and moral knowledge teaching positively affects academic achievement.

When the independent effect values of the studies in Table 1 were classified qualitatively, it was found that 3 studies were small (between 0.15-0.40), 3 studies were medium (0.40-0.75), 8 studies were large (0.75-1.10), 3 studies were very large (1.10-1.45) and 3 studies were at an excellent level (1.45 and above). Therefore, in general, it can be said that each study has a large or above effect size. The combined effect values of the relevant studies according to study weights and different meta-analysis models are given in Table 2.

Table 2
Combined Effect Sizes of Studies According to Different Models

Models	n	*Z*	*p*	*Q*	$\chi 2$	Effect Size	Confidence Interval	
							Lower	Upper
Fixed (FEM)	20	14.861	0.000	56.975	30.144	0.894	0.777	1.012
Random (REM)	20	9.001	0.000	56.975	30.144	0.969	0.758	1.180

Table 2 shows that Z values are statistically significant in FEM and REM models (14.861; 9.001, $p<0.05$). From this point of view, it can be said that the combined effect values obtained in different models as a result of meta-analysis are also significant. Due to the limitations of the current study, the REM model was preferred. However, in order to reveal the validity of the models, the Q value obtained was compared with the $\chi 2$ table value at alpha 0.05 and 19 degrees of freedom. It was determined that the Q value presented in Table 2 was 56.975 and the critical value of the $\chi 2$ distribution was 30.144. Therefore, it was observed that the Z value was greater than the critical value of $\chi 2$ distribution, that is, it was significant. From this point of view, it was determined that the effect sizes of the studies showed a heterogeneous distribution and it was determined that it was appropriate to use the REM model to determine the general effect size. According to the REM model, the combined effect value of the independent studies was calculated as 0.969, and the lower limit of this value in the 95% confidence interval was 0.758 and the upper limit was 1.180. According to these values, it was determined that student-centred teaching had a large effect on academic achievement in religious culture and moral knowledge teaching.

Discussion, Conclusions and Suggestions

In this study, it was tried to reveal the effect of student-centred teaching on academic achievement in religious culture and moral knowledge teaching. In this context, 25

undergraduate education theses that were scanned in HEC Thesis Centre and met the inclusion criteria constituted the data of the study. In the analysis process, 20 effect sizes produced from 16 studies were handled independently. Then, based on these effect sizes, the combined overall effect size was calculated and interpreted. According to the findings obtained in the study, it was seen that student-centred teaching had a statistically significant and positive effect on academic achievement in religious culture and moral knowledge teaching. It was determined that this effect was in favour of the experimental groups teaching with student-centred teaching and against the control groups teaching with traditional teaching methods other than student-centred teaching. In this context, it is understood that student-centred teaching in religious culture and moral knowledge course affects students' academic achievement more positively than traditional teaching.

According to the findings obtained in this study, each independent study of student-centred instruction had a positive effect on academic achievement in religious culture and moral knowledge teaching. When the independent effect values of the studies were analysed, the studies conducted by Türker (2024), Demir (2016) and Özcan (2024) differed from the other studies by showing excellent effect values. Türker (2024), who has the highest effect value, used educational games in his study. In general, educational games increase students' participation in the lesson, increase their motivation and provide them with a sense of success (Alonso-Fernandez et al., 2020). Toraman, Çelik, and Çakmak (2018) conducted a meta-analysis study to reveal the effect of educational games on academic achievement within the scope of game-based learning. As a result of the study, it was determined that educational games had a large effect on academic achievement (0.861). In Türker's (2024) study, it was found that educational games had an excellent independent effect on academic achievement (2.458). This may be due to the nature of religious culture and moral knowledge teaching. Because religious culture and moral knowledge teaching deals with abstract phenomena as a subject area and it is known that the concretisation process is difficult. The fact that educational games provide learning by doing-living may have been effective in terms of concretisation, but this situation may also have resulted from the bias in sample selection (Burak, 2022). Because the purposeful selection of the sample may cause a bias and cause extreme results from the effect value. On the other hand, in Demir's (2016) and Özcan's (2024) studies, it was observed that flipped learning environments had an excellent effect on academic achievement in religious culture and moral knowledge teaching. In different meta-analyses in the literature, it has been reported that flipped learning environments have a positive effect on academic achievement (Karagöl & Esen, 2018; Koruyucu & Tabak, 2020). The findings obtained in the current study revealed that flipped learning environments in religious culture and moral knowledge teaching affect academic achievement at an excellent level. In the literature, it is generally reported to have a moderate or above effect. However, Karagöl and Esen (2018) revealed in their meta-analysis study that the effect of flipped learning approach on academic achievement is higher in small groups. In this context, it can be thought that this differentiated effect value may be due to the sample size.

According to the findings obtained in the present study, the combined effect value of the studies included in the meta-analysis positively affects academic achievement to a large extent. Therefore, it was found that student-centred teaching in religious culture and moral knowledge teaching has a positive and significant effect on academic achievement. In the literature, some studies have reported that student-centred teaching generally affects academic achievement positively. For example, Kurt et al. (2024) in life science teaching and Yaşar et al. (2015) in social studies teaching found that student-centred teaching positively affected academic achievement. In this context, the findings obtained in the current study overlap with different teaching areas in the literature. This situation confirms that student-centred teaching has a widespread effect on the basis of the field.

According to the findings obtained in the study, it was concluded that student-centred teaching environments significantly increase academic achievement in religious culture and moral knowledge teaching. In this direction, teachers can benefit from methods and techniques such as educational games, flipped learning, brain-based learning, multiple intelligence and peer teaching from student-centred activities to create an effective and efficient teaching environment in religious culture and ethics teaching. In this context, teachers can make adaptations in line with the achievements, student characteristics (Burak & Gültekin, 2024) and available opportunities while using these methods and techniques whose effects have been revealed. Because it may be a limitation to reduce the creation of an effective teaching environment only to the characteristics of the method used.

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Research Article
Received: 14.11.2024
Accepted: 30.12.2024
Published 31.12.2024

Citation: Demir, S., & Demir, Y. (2024). An investigation of secondary school learners' critical thinking inclination. *International Journal of Scholars in Education*, *7*(2), 138-156. https://doi.org/ 10.52134/ueader.1585270

Ortaokul Öğrencilerinin Eleştirel Düşünme Eğilimlerinin İncelenmesi

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***Öz*:** Toplumların inşasında önemli bir yeri olan öğrencilerin eleştirel düşünme eğilimlerinin belirlenmesinin ve eğilimleri üzerinde etkili olan ya da farklılık oluşturan faktörlerin ortaya konulması gerek günümüz gerekse gelecek adına önemlidir. Bu bağlamda bu araştırmanın amacını ortaokul öğrencilerinin eleştirel düşünme eğilimlerini belirlemek ve bu eğilimlerini cinsiyet, yaş, akademik başarı, anne ve baba eğitimi, sahip olunan ve okunan kitap sayısı değişkenlerine göre incelemek oluşturmaktadır. Araştırma nicel araştırma yöntemlerinden biri olan tarama desenine göre tasarlanmış olup araştırmanın örneklemini 2024-2025 eğitim öğretim yılı güz döneminde ortaokul kademesinde öğrenim gören 529 çocuk oluşturmaktadır. Araştırmanın verileri toplanırken "Kişisel Bilgi Formu" ve "UF/EMI Eleştirel Düşünme Eğilim Ölçeği" kullanılmıştır. Araştırma verileri "SPSS 21.00 istatistik programı" ile analiz edilmiştir. Veriler normal dağılım gösterdiği için istatistiksel analizlerde parametrik testler kullanılmıştır. Araştırma sonucunda ortaokul öğrencilerinin eleştirel düşünme eğilimlerinin orta düzeyde olduğu belirlenmiştir. Ayrıca öğrencilerin eleştirel düşünme eğilimlerinin cinsiyet, yaş, akademik başarı, baba eğitimi, sahip olunan ve okunan kitap sayısı değişkenlerine göre istatistiksel olarak anlamlı bir farklılık gösterdiği ancak anne eğitiminin anlamlı bir farklılığa yol açmadığı belirlenmiştir.
Anahtar Kelimeler: Eleştirel düşünme, Eğilim, Ortaokul öğrencileri.

An Investigation of Secondary School Learners' Critical Thinking Inclination

***Abstract*:** It is important to determine the critical thinking inclination of learners, who have an important place in the construction of societies, and to reveal the factors that are effective on their inclinations or that make a difference on behalf of both the present and the future. In this context, the aim of this study is to determine the critical thinking inclinations of secondary school learners and to examine these inclinations according to the variables of gender, age, academic achievement, mother and father education, number of books owned and read. The research was designed according to the survey design, which is one of the quantitative research methods, and the sample of the research consists of 529 children studying at the middle school level in the fall semester of the 2024-2025 academic year. "Personal Information Form" and "UF/EMI Critical Thinking Disposition Scale" were used to collect the data. The research data were analysed with "SPSS 21.00 statistical program". Since the data were normally distributed, parametric tests were used in statistical analysis. As a result of the research, it was determined that the critical thinking inclinations of middle school learners were at a medium level. In addition, it was determined that the critical thinking inclinations of the learners showed a statistically significant difference according to the variables of gender, age, academic achievement, father's education, number of books owned and read, but mother's education did not cause a significant difference.
Keywords: Critical thinking, Inclination, Secondary school learners.

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Introduction

One of the abilities that individuals should have today is critical thinking. Indeed, "critical thinking plays a critical role in the development, progress and change of societies" (Uyar, 2023, p. 63). Critical thinking is a mental process that is very effective in making sense of events by being aware of one's own cognitive processes and intentionally applying what is learned by taking into account the thought processes of other individuals (Cüceloğlu, 1995). Ennis (2011) defines critical thinking as a method of thinking that allows the individual to decide what to believe or what to choose wisely in the most accurate way, while Lipman (2003) defines it as a way of thinking that is aware of evidence and conclusions. In general terms, "critical thinking requires first being aware of a situation among various stimuli and messages. It involves a process that aims to make decisions in a rational, logical, courageous and prudent manner by clearly articulating the issue or problem and thinking systematically in the context of various alternatives. Critical thinking is a questioning guide" (Bakır & Eğmir, 2022, p. 25). In brief, critical thinking is "a type of thinking that includes mental processes and activities such as identification, comprehension, analysis, evaluation, synthesis and decision-making" (Mete, 2021, p. 493).

Critical thinking is also expressed as reflective and logical thinking that enables individuals to decide how to act in various situations (Ennis, 1987). Critical thinking "has an important place in the change, development and progress of free societies because it is through critical thinking that individuals who make up the society understand and interpret life, solve the problems they face and make decisions" (Mete, 2021, p. 492). Critical thinking is a way of thinking that enables one to form predictions about the causes and consequences of an event or phenomenon by questioning and basing it on evidence rather than accepting the existing as it is. Although this way of thinking is more frequently mentioned with the new century, its history goes back a long way (Çolak, Türkkaş-Anasız, Yorulmaz & Duman, 2019). The intellectual origin of critical thinking can be traced back to Socrates' questioning teaching method. Actually, Socrates emphasized that before accepting any idea, the individual should first ask in-depth questions about that question. This is the basis of critical thinking (Paul, Elder & Bartell, 1997).

It can be stated that critical thinking ability involves awareness of one's own knowledge repertoire and reasoning processes. A critical thinking individual should show the ability to keep his/her cognitive processes under control during the questioning process and to control these processes with a continuous reflective perspective (Yurdakul & Demirel, 2011). Critical thinking is used to analyze a problem, determine a better solution and the limits of existing solutions (Bakır & Eğmir, 2022). In critical thinking, any thought or information is examined in line with the evidence and the predicted results are revealed. In this respect, the basic assumption of critical thinking is that it focuses on finding meaningful and rational answers based on evidence (Watson & Glaser, 1964). Undoubtedly, critical thinking plays an important role in the formation of free societies, in other words, in the change, progress, and development of these societies. Indeed, critical thinking comes into play in individuals' understanding and interpretation of life, solving the problems they encounter, and in their decision-making processes, which form the foundation of societies. It can be claimed that individuals who research, question, think creatively and critically, make decisions and solve the problems they face have 21st century skills. Actually, critical thinking, which has an important place in reaching the right information and using it, is among the 21st century skills (Mete, 2021). The tendency to think critically is a tendency that provides a mental discipline, improves the quality of life and at the same time prepares the ground for a democratic society (Ocak, Eymir & Ocak, 2016, p. 67). In this context, it can be claimed that critical thinking encompasses a large number of mental or intellectual abilities such as proving the truth, reality and reliability of an information, idea or hypothesis, determining different criteria in matters to be decided, trying to

find evidence of the events around him/her, waiting for people's claims and thoughts to be proven on certain grounds before accepting them, being honest, being open, being consistent and truthful (Özdemir, 2005).

Individuals with critical thinking skills are individuals who can use effective communication language, measure the reliability of sources, ask logical questions, distinguish inconsistent judgments, consider fcognitive errors and prejudices, and have metacognitive awareness (Kökdemir, 2003). Individuals with critical thinking skills value the ideas they believe in rather than popular ideas. They use discussions to clarify problems and evaluate the ideas that emerge based on them. They distinguish between thoughts, prejudices and assumptions that may cloud their minds in order to reach enlightened thoughts and reach genuine conclusions through a planned reasoning system using reliable information. They review thinking strategies and problem-solving tools and apply the most appropriate method to the current situation (Bakır & Eğmir, 2022). The earlier an individual learns and develops this skill, the more prepared he/she will be for life. There are many factors that affect the learning and development of critical thinking abilities. These can be related to the individual himself/herself, as well as his/her family, environment and educational life (Basmaz, 2017).

When the literature is examined, it was observed that many studies on critical thinking have been conducted especially in recent years. In this context, critical thinking has been studied at primary/secondary school level (Altan, 2020; Amanvermez-İncirkuş, 2021; Bakır & Eğmir, 2022; Bayındır, 2015; Bozpolat & Güçcük-Kurga, 2021; Demir, 2006; Elçi et al, 2020; Görücü, 2014; Kandemir & Eğmir, 2020; Karabacak, 2011; Kıran, 2019; Köksal & Söğmen, 2018; Küçükbatman & Kılıç, 2018; Mete, 2021; Oflas, 2009; Saysal-Araz, 2013; Yavuz, 2019; Yıldız, 2011); high school/secondary education level (Akbıyık & Seferoğlu, 2006; Ay & Akgöl, 2008; Ay, 2005; Başbay, 2013; Boldaz, 2022; Demir & Aybek, 2014) and university level (Beşoluk & Önder, 2010; Çetinkaya, 2011; Çolak, Türkkaş-Anasız, Yorulmaz & Duman, 2019; Emir, 2012; Hastaoğlu, Mollaoğlu, Başer & Mollaoğlu, 2018; Kanbay, Işık & Aslan, 2011; Kandemir, 2017; Kartal, 2012; Ocak, Eymir & Ocak, 2016; Oğuz & Sarıçam, 2016; Özgün, 2019; Pekdoğan & Bayar, 2016; Tümkaya, 2011; Yıldırım & Şensoy, 2017; Yüksel & Alcı, 2012; Yüksel, Uzun & Dost, 2013; Zayif, 2008) learners were taken as a sample and their critical thinking inclinations/ skills were examined.

Critical thinking, which has an important function in individuals' future life successes and social participation, is also a skill that develops people's problem-solving abilities. The middle school period, during which children continue their education, coincides with a time of intense and complex emotional, cognitive, and mental development. Therefore, revealing the inclinations es of middle school learners who continue their education in critical thinking, and understanding and developing their emotional, cognitive, and mental skills, is a critical task (Uyar, 2023). Actually, it is very important to determine the critical thinking inclinations of learners attending secondary school and to reveal the factors that may be effective on these inclinations. As Uyar (2023) also stated, it is essential to conduct relevant research to understand how learners use their critical thinking abilities and evaluate information. In addition, important data can be obtained through research that samples secondary school children to understand how learners' critical thinking abilities can be integrated into curricula and educational policies. Moreover, such studies can also serve to develop and strengthen the critical thinking abilities of middle school learners, providing support for their future success through the introduction of various strategies.

As mentioned above, there are various studies in the literature in which middle school learners are taken as a sample and examined. For example, Demir (2006) examined the critical thinking levels of primary school fourth and fifth grade learners in the social studies course in the context of various variables. Oflas (2009) examined the critical thinking ability levels of

primary school learners, Bayındır (2015) examined the critical thinking inclinations of learners at the second level of primary education, while Köksal and Söğmen (2018) examined the communication skills and critical thinking of secondary school learners. In similar research, Elçi et al. (2020) examined the critical thinking inclinations of middle school learners. Yıldız (2011) examined the critical thinking levels of sixth grade primary school learners in science and technology course in the context of various variables; Saysal-Araz (2013) examined the relationship between technology and science literacy levels and critical thinking of fourth and fifth grade primary school learners. Küçükbatman and Kılıç (2018) examined the relationship between fifth-grade learners' critical thinking inclinations and values and the extent to which critical thinking inclinations predict the values of learners in the context of various variables. Altan (2020) examined the critical thinking abilities of middle school children in the context of some demographic characteristics. Kandemir and Eğmir (2020) examined the relationship between academic self-efficacy and critical thinking abilities of secondary school learners in the context of various variables. Mete (2021) determined the critical thinking levels of eighth grade middle school learners and examined these abilities in the context of gender, family structure, number of siblings, mother and father education level, reading habits, sports / art education and academic achievement in Turkish course. In a similar study, Amanvermez-İncirkuş (2021) evaluated the critical thinking inclinations of middle school learners in terms of sub-dimensions and total scores and whether they varied according to Turkish course academic achievement, gender and class variables. Bozpolat and Güçcük-Kurga (2021) examined the critical thinking inclinations of eighth grade learners in terms of some variables. Bakır and Eğmir (2022) examined the relationship between metacognitive awareness and critical thinking inclinations of middle school learners. Uyar (2023) also examined the critical thinking inclinations of middle school learners. In this study, the critical thinking abilities of middle school children were examined in terms of more variables compared to other studies in the literature. Therefore, it is thought that the results of this research are important in terms of providing the opportunity to compare the results of the studies in the literature in similar and different aspects and providing up-to-date data. Based on these, the problem statement of this research was formed as; "What is the level of critical thinking inclinations of secondary school learners and does gender, age, academic achievement, mother and father education level, number of books owned and read make a statistically significant difference on these inclinations?"

Method

The survey design was used in this research to determine the critical thinking inclinations of secondary school learners and to reveal significant differences according to some variables. Karasar (2011) explains the survey design as "all kinds of screening arrangements made on the whole universe or a group, sample or sample from it in order to reach a general judgment about this universe in a universe consisting of more than one number of elements" (p.79). Büyüköztürk et al. (2016) explained this design, which is one of the quantitative research designs, as research studies in which the opinions, interests, abilities, attitudes, attitudes, concerns, etc. of individuals towards an event or subject are determined and which are carried out on relatively larger samples compared to other studies.

Universe / Sample

While the universe of study consists of all secondary school students in Kilis province, the sample group consists of 529 secondary school students studying in a state secondary school in the central district of Kilis province in the 2024-2025 academic year. The sample of the study was determined using the simple random sampling method. In this method, each sampling unit is given an equal probability of being selected, which means that each sample from the sample space is selected with equal probability (Burak, 2022; Çıngı, 1994). Of the middle school

learners aged between 11-14 years, 287 (54.3%) were girls and 242 (45.7%) were boys. Additional information about the research group can be found in Table 1.

Table 1
Descriptive Information of the Research Group

Gender	n	%
Female	287	54.3
Male	242	45.7
Age	n	%
11 years and under	109	20.6
12 years	192	36.3
13 years and over	228	43.1
Mother's education	n	%
Primary school graduate	133	25.1
Secondary school graduate	158	29.9
High school graduate	150	28.4
Bachelor's/Postgraduate degree	88	16.6
Father's education	n	%
Primary school graduate	105	19.8
Secondary school graduate	115	21.7
High school graduate	136	25.7
Bachelor's/Postgraduate degree	173	32.7

Data Collection

The data collection tools of the research consisted of the "Personal Information Form" created by the researchers and the "UF/EMI Critical Thinking Disposition Scale" adapted into Turkish by Ertaş-Kılıç and Şen (2014).

Personal information form

The research group's "gender, age, academic achievement, parental and maternal education, number of books read and owned per month" were collected through the "Personal Information Form" created by the researcher.

Critical Thinking Disposition Scale

The "UF/EMI Critical Thinking Disposition Scale" used in this research was developed by researchers at the University of Florida and adapted into Turkish by Ertaş-Kılıç and Şen (2014). As a result of the "confirmatory factor analysis" (CFA) conducted to examine the three-factor structure of the 26-item five-point Likert-type "Critical Thinking Disposition Scale" consisting of participation, cognitive maturity and innovativeness, one statement was removed from the scale and 25 statements remained. In this context, the lowest score that can be obtained from the entire measurement tool is 25, while the highest score is 125. In order to determine the reliability of the "Critical Thinking Disposition Scale", internal consistency coefficients for both the whole scale and its sub-dimensions were also checked. So, the Cronbach's alpha internal consistency coefficient for the whole scale was found to be 0.91, 0.70 for the cognitive maturity sub-dimension, 0.88 for the participation sub-dimension and 0.73 for the innovativeness sub-dimension (Ertaş-Kılıç & Şen, 2014).

Analysis of Research Data

In this study, "Personal Information Form" and "UF/EMI Critical Thinking Disposition Scale" were administered to the children together. The data obtained from the scale forms,

which were completed in an average of 15 minutes, were first transferred to the "SPSS 21.00" statistical program and the necessary analysis was performed. Before the analysis, the normality tests of the data were checked and it was examined whether the variances were homogeneous. In this context, it was determined that the data showed normal distribution (Kolmogorov-Smirnov and Shapiro-Wilk significance value= p >.05). Therefore, parametric tests were used in statistical analyses. In the analysis phase, as Seçer (2015) stated, "t-test for independent samples was used to compare the values of two groups on a continuous variable" and "one-factor analysis of variance (One-Way Anova) was used to measure the effects of an independent variable with three or more than three levels on a continuous dependent variable". During the one-factor analysis of variance, if the difference between the mean scores was significant, that is, if the variances were homogeneous, the "Post Hoc Tukey" test was performed, and if the variances were not homogeneous, the "Post Hoc Tamhane" test was performed. In addition to these, mean, standard deviation, percentage and frequency values, which are basic statistical procedures, were calculated. The significance of p<.05 was taken as a basis in the analysis results.

Findings

In this study, firstly, a descriptive analysis of the data on the critical thinking trends of secondary school learners was conducted. Then, statistical analyses on whether the critical thinking inclinations of learners show a significant difference according to the variables of "gender, age, academic achievement, mother and father education, number of books owned and read" were included.

Descriptive Data on Learners' Critical Thinking Inclinations

The "Critical Thinking Disposition Scale" developed for children consists of three five-point Likert-type dimensions and 25 statements. For this reason, the lowest score that can be obtained from this measurement tool is 25 points, while the highest score that can be obtained is 125 points. In this context, when the critical thinking trends levels of learners attending secondary school were evaluated in three groups as low (25-58), moderate (58-92) and good (92-125), it was concluded that the mean of the learners' critical thinking inclination was $\bar{X}$=89.38 according to the results obtained from the measurements in this study. This finding shows that the critical thinking trends of learners attending secondary school are at a moderate level.

Differences in Learners' Critical Thinking Inclinations According to Gender

In order that determine whether there is a significant difference in the critical thinking trends of secondary school learners according to gender, "t-test for independent samples" analysis was performed and the results are given in Table 2. However, before presenting the results of this analysis, it was first examined whether the homogeneity of variances condition, which is an important precondition of the t-test for independent samples, was met. In this context, it was determined that the variances of "cognitive maturity" (p=.430; p>.05) and "innovative thinking" (p=.413; p>.05), which are sub-dimensions of critical thinking inclination, were homogeneous, while the variances of "participation" (p=.004; p<.05) and general "critical thinking" inclination (p=.017; p<.05) were not homogeneous.

Table 2
Critical Thinking Inclinations of Learners by Gender

Dimension	Gender	n	$\bar{X}$	sd	*t*	*p*
Participation	*A	287	37.63	5.96	1.695	.091
	*B	242	36.66	7.19		
Cognitive maturity	*A	287	26.35	4.89	1.956	.051
	*B	242	25.51	4.93		
Innovative thinking	*A	287	26.60	4.64	1.981	.048
	*B	242	25.76	5.07		
Critical thinking	*A	287	90.59	13.32	2.127	.036
	*B	242	87.94	15.28		

**A: Female, B: Male, n=529; p<.05*

As seen in Table 2, "t-test for independent samples" was conducted to determine whether the "participation", "cognitive maturity" and "innovative thinking" trends, which are sub-dimensions of critical thinking tendency, and general critical thinking inclinations of secondary school learners differed significantly according to gender. As a result of the analysis, it was determined that the difference between the averages was significant in terms of "innovative thinking" (t_{527}= 1.981; p<.05) and general "critical thinking" (t_{482}= 2.127; p<.05) inclinations. When the averages are taken into consideration, it can be claimed that there is a significant result in favor of girls and that the critical thinking tendency of female secondary school learners is higher than that of boys. However, there was no significant difference between the averages in the "participation" (t_{468}= 1.695; p>.05) and "cognitive maturity" (t_{527}= 1.956; p>.05) sub-dimensions of critical thinking trends. Therefore, it can be claimed that the inclinations of male and female learners are equivalent for both dimensions.

Differences in Learners's Critical Thinking Inclinations by Age

One-factor analysis of variance (One-Way Anova) was conducted to determine whether the critical thinking trends of secondary school learners showed a significant difference according to age and the results are given in Table 3. However, before giving the results of this analysis, it was first examined whether the homogeneity of variances, which is an important precondition of One-Way Anova, was met. In this context, it was determined that the variance of "participation" (p= .197; p>.05), one of the sub-dimensions of critical thinking trends, was homogeneous. However, the variances of "cognitive maturity" (p=.006; p<.05), "innovative thinking" (p= .000; p<.05) and general "critical thinking" tendency (p= .001; p<.05) were not homogeneous.

Table 3
Critical Thinking Inclinations of Learners According to Age

Dimension	Age level	n	$\bar{X}$	sd	df	F	*p*	Significant difference
Participation	*A	109	35.90	7.06	2/526	5.851	.003	*A-B/C
	*B	192	37.88	5.94				
	*C	228	37.98	6.59				
Cognitive maturity	*A	109	24.96	5.36	2/526	6.882	.001	*A-B/C
	*B	192	26.35	4.26				
	*C	228	26.92	5.14				
Innovative thinking	*A	109	25.21	5.67	2/526	6.871	.001	*A-B/C
	*B	192	26.65	3.94				
	*C	228	27.08	4.76				
Critical thinking	*A	109	86.09	16.06	2/526	8.407	.000	*A-B/C
	*B	192	90.90	11.54				
	*C	228	91.99	15.25				

**A: 11 years and under, B: 12 years, C: 13 years and over, n=529; p<.05*

As seen in Table 3, "one-factor analysis of variance (One-Way Anova)" was performed to determine whether "participation", "cognitive maturity" and "innovative thinking" trends, which are sub-dimensions of critical thinking inclination, and general critical thinking inclinations differed significantly according to age. As a result of the analyses, it was found that the difference between the averages was statistically significant in "participation" (F_{526}= 5.851; p<.05), "cognitive maturity" (F_{526}= 6.882; p<.05), "innovative thinking" (F_{526}= 6.871; p<.05) and "critical thinking" (F_{526}= 8.407; p<.05) inclination and all of its sub-dimensions. In the analyzes, it was determined that the critical thinking tendency of the learners who attended secondary school "11 years old and younger" was lower than the "12 years old" and "13 years old and older" learners. In general, when the critical thinking trends of learners attending secondary school according to age are evaluated, it can be claimed that the critical thinking inclinations of learners attending secondary school increase as their ages increase.

The Difference of Learners's Critical Thinking Inclinations According to Academic Achievement

One-factor analysis of variance (One-Way Anova) was conducted to determine whether the critical thinking trends of secondary school learners showed a significant difference according to academic achievement and the results are given in Table 4. However, before giving the results of this analysis, it was first examined whether the homogeneity of variances, which is an important precondition of One-Way Anova, was met. In this context, it was determined that the variances of "participation" (p=.121; p>.05) and "cognitive maturity" (p=.080; p>.05), which are sub-dimensions of critical thinking trends, were homogeneous. However, the variances of the "innovative thinking" dimension (p=.009; p<.05) and the general "critical thinking" tendency (p=.006; p<.05) were not homogeneous.

Table 4
Critical Thinking Inclinations of Learners According to Academic Achievement

Dimension	Academic achievement level	n	$\bar{X}$	sd	df	F	p	Significant difference
Participation	*A	69	31.84	5.88	4/524	23.099	.000	*A-B/C/D/E
	*B	85	36.34	6.46				*B-E
	*C	120	36.87	6.78				*C-E
	*D	120	37.62	6.01				*D-E
	*E	135	40.34	5.24				
Cognitive maturity	*A	69	23.50	5.12	4/524	9.170	.000	*A-C/D/E
	*B	85	25.00	4.76				*B-E
	*C	120	26.04	4.85				*C-E
	*D	120	26.25	5.26				*D-E
	*E	135	27.53	4.03				
Innovative thinking	*A	69	24.36	5.32	4/524	10.554	.000	*A-D/E
	*B	85	25.85	5.39				*B-E
	*C	120	25.10	4.75				*C-E
	*D	120	26.45	4.73				*D-E
	*E	135	28.19	3.66				
Critical thinking	*A	69	79.71	14.08	4/524	18.270	.000	*A-B/C/D/E
	*B	85	87.20	14.86				*B-E
	*C	120	88.02	14.40				*C-E
	*D	120	90.32	13.98				*D-E
	*E	529	89.38	14.30				

**A: Very Low, B: Low, C: Medium, D: Good, E: Very good, n=529; p<.05*

As seen in Table 4, “one-factor analysis of variance (One-Way Anova)” was conducted to determine whether “participation”, “cognitive maturity” and “innovative thinking” inclinations, which are sub-dimensions of critical thinking trends, and general critical thinking inclinations differ significantly according to academic achievement. As a result of the analysis, it was found that the difference between the averages was statistically significant in “participation” (F_{524}= 23.099; p<.05), “cognitive maturity” (F_{524}= 9.170; p<.05), “innovative thinking” (F_{524}= 10.554; p<.05) and “critical thinking” (F_{524}= 18.270; p<.05) tendency and all of its sub-dimensions. In the analysis, it was determined that secondary school learners with “very low” academic achievement had a lower level of critical thinking trends than learners with “low”, “medium”, “good” and “very good” academic achievement. In addition, there was a significant difference between the critical thinking trends of children with “very good” academic achievement and those with “low”, “medium” and “good” academic achievement in favor of children with “very good” academic achievement. In general, it can be claimed that as the average academic achievement of secondary school learners increases, their critical thinking trends also increase.

The Difference of Learners’ Critical Thinking Inclinations According to Mother's Education

One-factor analysis of variance (One-Way Anova) was conducted to determine whether the critical thinking trends of secondary school learners showed a significant difference according to their mother’s education and the results are given in Table 5. However, before giving the results of this analysis, it was first examined whether the homogeneity of variances, which is an important precondition of One-Way Anova, was met. In this context, it was determined that the variances of “participation” (p=.205; p>.05), “innovative thinking” (p=.076; p>.05) and general “critical thinking” tendency (p=.455; p>.05), which are sub-dimensions of critical thinking tendency, were homogeneous. However, it was determined that the variances of the “cognitive maturity” dimension (p=.047; p<.05) were not homogeneous.

Table 5
Critical Thinking Inclinations of Learners According to Mother’s Education

Dimension	Mother’s education	n	$\bar{X}$	sd	df	F	p	Significant difference
Participation	*A	133	36.20	6.06	3/525	2.098	.100	---
	*B	158	37.46	6.05				
	*C	150	37.06	7.30				
	*D	88	38.38	6.72				
Cognitive maturity	*A	133	25.83	4.05	3/525	1.692	.168	---
	*B	158	25.63	5.46				
	*C	150	25.82	4.93				
	*D	88	27.03	5.02				
Innovative thinking	*A	133	26.47	4.27	3/525	3.400	.018	*C-D
	*B	158	26.06	5.12				
	*C	150	25.44	5.25				
	*D	88	27.45	4.25				
Critical thinking	*A	133	88.51	12.36	3/525	2.213	.086	---
	*B	158	89.17	14.49				
	*C	150	88.32	15.33				
	*D	88	92.87	14.55				

** A: Primary school graduate, B: Secondary school graduate, C: High school graduate, D: Bachelor’s/Postgraduate degree, n=529; p<.05*

As seen in Table 5, “one-factor analysis of variance (One-Way Anova)” was performed to determine whether “participation”, “cognitive maturity” and “innovative thinking”

inclinations, which are sub-dimensions of critical thinking tendency, and general critical thinking inclinations differ significantly according to mother's education. In consequence of the analysis, it was determined that the difference between the averages was significant only in terms of the sub-dimension of "innovative thinking" (F_{525}= 3.400; p<.05). It was concluded that the difference between primary school graduates and undergraduate/graduate graduates was in favor of the learners whose mothers were undergraduate/graduate graduates. No significant result was reached in terms of "participation" and "cognitive maturity", which are sub-dimensions of critical thinking trends, and the overall "critical thinking" trends. Therefore, in this study, it can be claimed that the critical thinking tendency of learners attending secondary school according to their mother's education is equivalent to each other.

The Difference of Learners' Critical Thinking Inclinations According to Father's Education

One-factor analysis of variance (One-Way Anova) was conducted to determine whether there was a significant difference in the critical thinking inclinations of secondary school learners according to their father's education and the results are given in Table 6. However, before giving the results of this analysis, it was first examined whether the homogeneity of variances, which is an important precondition of One-Way Anova, was met. In this context, it was determined that the variances of "participation" (p=.272; p>.05), "cognitive maturity" (p=.823; p>.05), "innovative thinking" (p=.080; p>.05) and general "critical thinking" tendency (p=.777; p>.05), which are sub-dimensions of critical thinking tendency, were all homogeneous.

Table 6
Critical Thinking Inclinations of Learners According to Father's Education

Dimension	Father's education	n	$\bar{X}$	sd	df	F	p	Significant difference
Participation	*A	105	36.61	6.93	3/525	2.128	.096	----
	*B	115	36.14	6.65				
	*C	136	37.55	6.08				
	*D	173	37.93	6.57				
Cognitive maturity	*A	105	26.18	4.74	3/525	2.692	.046	*A-D
	*B	115	25.39	5.06				
	*C	136	25.34	5.08				
	*D	173	26.72	4.73				
Innovative thinking	*A	105	26.59	4.72	3/525	4.013	.008	*A-D
	*B	115	25.00	5.58				
	*C	136	26.05	4.76				
	*D	173	26.94	4.33				
Critical thinking	*A	105	89.39	14.26	3/525	2.976	.031	*A-D
	*B	115	86.53	14.82				
	*C	136	88.95	13.93				
	*D	173	91.60	14.00				

**A: Primary school graduate, B: Secondary school graduate, C: High school graduate, D: Bachelor's/Postgraduate degree, n=529; p<.05*

As seen in Table 6, "one-factor analysis of variance (One-Way Anova)" was performed to determine whether "participation", "cognitive maturity", "innovative thinking" and general critical thinking inclinations, which are sub-dimensions of critical thinking trends, differed significantly according to father's education. "Post Hoc Tukey" test was performed to determine which groups the difference was between. In consequence of the analysis, no statistically significant result was found for the "participation" dimension (F_{525}= 2.128; p>.05). However, a statistically significant result was reached for "cognitive maturity" (F_{525}= 2.692; p<.05) and "critical thinking" (F_{525}= 2.976; p<.05) tendency and "innovative thinking" (F_{525}= 4.013; p<.05).

In the analyses, it was determined that the significant difference was in favor of the children whose father's education was "primary school graduate" and those whose father's education level was "undergraduate /graduate" in favor of the children whose father's education level was "undergraduate/graduate".

The Difference of Learners' Critical Thinking Inclinations According to the Number of Owned Books

One-factor analysis of variance (One-Way Anova) was conducted to determine whether there was a significant difference in the critical thinking trends of secondary school learners according to owned book and the results are given in Table 7. However, before presenting the results of this analysis, it was first examined whether the homogeneity of variances, which is an important precondition of One-Way Anova, was met. In this context, it was determined that the variances of "participation" (p=.735; p>.05), "innovative thinking" (p=.241; p>.05) and general "critical thinking" tendency (p=.384; p>.05), which are sub-dimensions of critical thinking tendency, were homogeneous. However, it was determined that the variances of the "cognitive maturity" dimension (p=.006; p<.05) were not homogeneous.

Table 7
Critical Thinking Inclinations of Learners According to Owned Book

Dimension	Number of owned book	n	$\bar{X}$	sd	df	F	p	Significant difference
Participation	*A	151	35.10	6.77	4/524	9.860	.000	*A-C/D/E
	*B	129	36.62	6.56				*B-E
	*C	87	37.49	6.16				*C-E
	*D	72	37.79	5.69				
	*E	90	40.30	6.19				
Cognitive maturity	*A	151	25.05	4.90	4/524	5.679	.000	*A-D/E
	*B	129	25.58	5.44				*B-E
	*C	87	25.37	5.18				*C-E
	*D	72	27.34	3.80				
	*E	90	27.53	4.15				
Innovative thinking	*A	151	25.57	4.90	4/524	2.293	.058	----
	*B	129	26.65	4.80				
	*C	87	25.78	5.37				
	*D	72	25.98	4.94				
	*E	90	27.31	4.05				
Critical thinking	*A	151	85.73	14.41	4/524	6.968	.000	*A-E
	*B	129	89.73	14.35				*B-E
	*C	87	87.78	15.03				*C-E
	*D	72	91.12	12.50				*A-D
	*E	90	95.14	12.75				

**A: 25 and less, B: Between 26-50, C: Between 51-75, D: Between 76-100, E: 101 and above, n=529; p<.05*

As seen in Table 7, "one-factor analysis of variance (One-Way Anova)" was performed to determine whether "participation", "cognitive maturity" and "innovative thinking" inclinations, which are sub-dimensions of critical thinking inclinations, and general critical thinking trends differed significantly according to owned book. "Post Hoc Tukey" test was performed to determine which groups the difference was between. In consequence of the analysis, no statistically significant result was found for the difference between the averages for the dimension of "innovative thinking" (F_{524}= 2.293; p>.05). However, a statistically significant result was reached for "critical thinking" (F_{524}= 6.968; p<.05) tendency and these two sub-dimensions, namely "participation" (F_{524}= 9.860; p<.05) and "cognitive maturity" (F_{524}= 5.679; p<.05). According to the results of the analysis, it was concluded that the critical thinking

inclinations of secondary school learners who have 101 or more books at home are significantly higher than those who have 100 or less owned books. In addition, it was determined that there was a significant difference between those who had 76-100 books and those who had 25 books or less in favor of those who had 76-100 books. Actually, in general, it can be claimed that as the number of books of secondary school learners increases, their critical thinking inclinations also increase.

The Difference of Learners' Critical Thinking Inclinations According to the Number of Books Read Per Month

One-factor analysis of variance (One-Way Anova) was conducted to determine whether there was a significant difference in the critical thinking trends of secondary school learners according to the number of books they read per month and the results are given in Table 8. However, before presenting the results of this analysis, it was first examined whether the homogeneity of variances, which is an important precondition of One-Way Anova, was met. In this context, it was determined that the variances of "participation" (p=.819; p>.05), "cognitive maturity" (p=.078; p>.05), "innovative thinking" (p=.058; p>.05) and general "critical thinking" tendency (p=.281; p>.05), which are sub-dimensions of critical thinking tendency, were all homogenous.

Table 8
Critical Thinking Inclinations of Learners According to the Number of Books Read per Month

Dimension	Number of book read monthly	n	$\bar{X}$	ss	df	F	p	Significant difference
Participation	*A	31	31.80	6.40	4/524	11.966	.000	*A-B/C/D/E *B-C/D/E
	*B	240	36.10	6.24				
	*C	158	38.70	5.92				
	*D	73	38.79	7.39				
	*E	27	39.74	5.68				
Cognitive maturity	*A	31	22.74	3.22	4/524	7.662	.000	*A-B/C/D/E *B-C/D/E
	*B	240	25.30	4.86				
	*C	158	27.15	4.45				
	*D	73	26.79	5.32				
	*E	27	26.44	6.13				
Innovative thinking	*A	31	25.16	3.89	4/524	5.462	.000	*A-B/C/D/E *B-C/D/E
	*B	240	25.34	4.98				
	*C	158	26.96	4.12				
	*D	73	27.17	5.60				
	*E	27	28.37	4.99				
Critical thinking	*A	31	79.70	10.70	4/524	10.461	.000	*A-B/C/D/E *B-C/D/E *A-B/C/D/E
	*B	240	86.75	13.94				
	*C	158	92.82	12.30				
	*D	73	92.76	16.76				
	*E	27	94.55	15.34				

**A: Less than a book, B: Between 1-5, C: Between 6-10, D: Between 11-15, E: 16 books and above, n=529; p<.05*

As seen in Table 8, "one-factor analysis of variance (One-Way Anova)" was conducted to determine whether "participation", "cognitive maturity" and "innovative thinking" inclinations, which are sub-dimensions of critical thinking tendency, and general critical thinking inclinations differ significantly according to books they read per month. "Post Hoc Tukey" test was performed to determine which groups the difference was between. In consequence of the analyses, it was found that the difference between the averages was statistically significant in "participation" (F_{524}= 11.966; p<.05), "cognitive maturity" (F_{524}= 7.662; p<.05), "innovative thinking" (F_{524}= 5.462; p<.05) and "critical thinking" (F_{524}= 10.461;

p<.05) inclination and all of its sub-dimensions. According to the results of the analysis, it was concluded that there was a significant difference between those who read five books or less and those who read six books or more in favor of those who read more. In this context, it can be claimed that as the number of books that middle school learners read per month increases, their critical thinking inclinations also increase.

Conclusion and Discussion

In this study, the critical thinking inclinations of learners attending secondary school were determined and these inclinations were examined according to gender, age, academic achievement, mother and father education level, number of books owned and read. In consequence of the study, it was determined that the critical thinking inclinations of learners attending secondary school were at a medium level. The studies conducted by Saysal-Araz (2013), Görücü (2014), Bayındır (2015), Kutlu-Kalender (2015), Kıran (2019), Yavuz (2019), Mete (2021) reached similar results. In these studies, it was concluded that the critical thinking levels of learners attending secondary school were at a medium level. Karabacak (2011), Köksal and Söğmen (2018), Bakır and Eğmir (2022) and Uyar (2023) determined that the critical thinking inclinations of learners attending secondary school were at a high level. However, in the study conducted by Yahşi-Cevher (2008), it was concluded that the critical thinking inclinations of learners attending secondary school were at a low level. Nevertheless, when the literature studies are examined in general terms, it can be claimed that the critical thinking inclinations of learners attending secondary school are medium and above.

When the critical thinking inclinations of learners attending secondary school according to gender were taken into consideration, it was concluded that there was a significant result in favor of girls and that girls had a higher tendency to think critically than boys. Similarly, it was concluded that the difference between the averages in the dimension of "innovation thinking" tendency, which is one of the sub-dimensions of critical thinking tendency according to gender, was significant in favor of girls. However, no significant difference was found between the averages in the dimensions of "participation" and "cognitive maturity" tendency, which are sub-dimensions of critical thinking trends, according to gender. Therefore, it was concluded that the inclinations of male and female learners were equivalent for both dimensions. Similar conclusions were reached in the studies conducted by Demir (2006), Yıldırım-Ankaralıgil (2009), Yıldız (2011), Karabacak (2011), Akıllı (2012), Saysal-Araz (2013), Küçükbatman and Kılıç (2018), Kıran (2019), Yıldırım (2019), Yüksekbilgili (2019), Altan (2020) and Amanvermez-İncirkuş (2021). In these studies, a significant difference was observed in favor of female learners in the critical thinking inclinations of learners attending secondary school according to gender variable. In the studies conducted by Yahşi-Cevher (2008), Görücü (2014), Bayındır (2015), Yavuz (2019), Elçi et al. (2020), Kandemir and Eğmir (2020), Mete (2021), Bakır and Eğmir (2022) and Uyar (2023), it was concluded that the critical thinking inclinations of learners attending secondary school did not differ according to gender. Therefore, when the literature is examined in general terms, the fact that the critical thinking inclinations of learners attending secondary school have a significant result in favor of girls and that there is no significant result in favor of boys in any study is quite meaningful, although it creates a parallelism in the literature. Because these results can be considered as an indication that some studies should be conducted to improve the critical thinking inclinations of male learners.

In the present study, it was concluded that the difference between the critical thinking tendency averages of learners attending secondary school according to the age factor was significant. In the analyses, it was determined that the critical thinking tendency of the learners attending secondary school "11 years old and below" was lower than the "12 years old" and "13 years old and above" learners. In general, it was concluded that the critical thinking tendency of

middle school learners increased as their age increased. A similar conclusion was reached in the study conducted by Ay and Akgöl (2008) on secondary school learners. In the said study, it was concluded that the critical thinking power of secondary school learners increased as their age increased. Amanvermez-İncirkuş (2021) explains the effect of age factor on critical thinking tendency as follows: "When the relationship between grade level, in other words, age or education level status and critical thinking is considered, it is generally thought that individuals gain more experience as they get older or their education level increases, so their critical thinking abilities increase in parallel with their age or education level" (p. 1275). Oflas (2009), Yıldırım (2019), Altan (2020) reached a similar conclusion. In these studies, it was concluded that the critical inclinations of learners attending secondary school increased as their age increased along with their class or education level. In the studies conducted by Bayındır (2015), Kandemir and Eğmir (2020), it was determined that the difference between the age level, in other words, the class variable and the learners' critical thinking inclination levels was statistically significant. However, it was concluded that this difference was in favor of groups with lower class level. In the studies conducted by Yahşi-Cevher (2008), Saysal-Araz (2013), Görücü (2014), Yıldırım-Döner (2020), Uyar (2023), it was concluded that learners' critical thinking inclinations did not differ according to the class level, in other words, the age factor. Therefore, it is seen that the results of these studies and the findings of the current study do not overlap in this respect.

In the current study, it was determined that the critical thinking tendency of learners attending secondary school showed a significant difference according to academic achievement. A similar conclusion was reached in the studies conducted by Kıran (2019) and Uyar (2023). In this context, in these studies, it was concluded that learners attending secondary school with higher critical thinking inclinations also had higher GPAs. Karabacak (2011) and Mete (2021) found a significant relationship between critical thinking inclinations of learners attending secondary school and their academic achievement in Turkish course; Yıldız (2011) found a significant relationship between critical thinking inclinations and academic achievement in science and technology course; Yavuz (2019) found a significant relationship between critical thinking inclinations and academic achievement in social studies course. Tümkaya (2011) and Kartal (2012) concluded that academic achievement has a significant effect on undergraduate learners' critical thinking inclinations.

In the current study, the effect of parental education level on the critical thinking inclinations of learners attending secondary school was also examined. In this context, it was concluded that the level of mother's education did not have any statistically significant effect on learners' critical thinking inclinations. A similar conclusion was reached in the studies conducted by Sadioğlu and Bilgin (2008), Yahşi-Cevher (2008), Basmaz (2017), Akıllı (2012), Çağlayan-Öztürk (2013), Ocak and Kutlu-Kalender (2017), Bayındır (2015), Yüksekbilgili (2019), Bozpolat and Güçcük-Kurga (2021), Uyar (2023). In these studies, it was concluded that the level of mother's education did not have any predictive effect on the critical inclination levels of learners attending secondary school. However, Oflas (2009), Yıldırım-Ankaralıgil (2009), Saysal-Araz (2013), Görücü (2014), Kutlu-Kalender (2015), Küçükbatman and Kılıç (2018), Kıran (2019), Yıldırım (2019), Altan (2020), Yıldırım-Döner (2020), Kandemir and Eğmir (2020), In the studies conducted by Mete (2021), Bakır and Eğmir (2022), it was concluded that the level of maternal education had a statistically significant effect on the critical thinking inclinations of learners attending secondary school. When it is examined whether there is a significant difference in the critical thinking tendency of secondary school learners according to their father's education level, it is concluded that the level of father's education has a statistically significant effect on the critical thinking inclinations of secondary school learners. A similar result was found in the studies conducted by Yahşi-Cevher (2006), Oflas (2009), Yıldırım-Ankaralıgil (2009), Akıllı (2012), Çağlayan-Öztürk (2013), Saysal-Araz (2013), Kutlu-Kalender (2015), Küçükbatman and Kılıç (2018), Kıran (2019), Yıldırım (2019), Altan

(2020), Yıldırım-Döner (2020), Kandemir and Eğmir (2020). In these studies, it was determined that as the level of father's education increased, the critical thinking inclinations of learners attending secondary school also increased. However, in the studies conducted by Sadioğlu and Bilgin (2008), Yahşi-Cevher (2008), Bakan (2010), Görücü (2014), Bayındır (2015), Yüksekbilgili (2019), Basmaz (2017), Mete (2021), no statistically significant relationship was found between the level of father's education and critical thinking tendency of learners attending secondary school.

In the current study, the effect of books on the critical thinking inclinations of learners attending secondary school was also examined. In this context, it was concluded that both the number of books learners read per month and the owned books have a statistically significant effect on the critical thinking inclinations of learners attending secondary school. Actually, when the literature is examined, it is seen that both the number of books at home (Basmaz, 2017) and the number of books read (Görücü, 2014; Kıran, 2019; Yıldırım, 2019; Yıldırım-Döner, 2020) have a statistically significant effect on the critical thinking inclinations of learners attending secondary school. In the studies conducted by Yahşi-Cevher (2008), Kutlu-Kalender (2015), Basmaz (2017), Eğmir and Ocak (2017), Ocak and Kutlu-Kalender (2017), no statistically significant relationship was found between the number of books read and critical thinking inclination.

When the findings obtained from the research are examined, it stands out as an important and noteworthy finding that all variables except one variable (mother's education level) create a significant difference on the critical thinking tendency of secondary school learners. It is thought that these results should be taken into consideration by all stakeholders of education, including learners, parents, educators and educational administrators, and reflected to the educational process. In addition, considering the results of this study and other studies in the literature, it is suggested that some studies should be conducted to improve the critical thinking inclinations of male learners. In addition, it may be recommended to conduct studies in which learners' metacognitive awareness will be examined in more depth with mixed or experimental methods.

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Research Article
Received: 31.10.2024
Accepted: 30.12.2024
Published: 31.12.2024

Citation: Güngördü Çevik, D., & Yılmaz, Z. A. (2024). The Effect of augmented reality applications on secondary school students' achievement of atom models and theirs attitudes. *International Journal of Scholars in Education*, *7*(2), 157-168. https://doi.org/10.52134/ueader.1577037

The Effect of Augmented Reality Applications on Secondary School Students' Achievement of Atom Models and Theirs Attitudes

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Abstract: The aim of this study is to examine the effects of Augmented Reality (AR) applications, which are a new approach in education, on students' achievement and attitudes. For this purpose, on the basis of science education, a content, which was consistent with the syllabus, about atomic structure and atom models in the topic of structure and properties of matter was developed by the experts for the 7^{th} grade students in secondary education and AR applications were integrated into the content. The Vuforia SDK software was used to design the content. The study was conducted on 205 secondary school students from six classes enrolled in a school in province of Gaziantep, in 2017-2018 academic year. Experimental group (n=103) and control group (n = 102) were randomly assigned. In this study, pretest-posttest with control group quasi-experimental design was used. The data of the study were collected using the achievement test, the Augmented Reality Applications Attitude Scale (ARAAS) and a semi-structured interview. The quantitative data were analyzed using t test while the qualitative data were analyzed using descriptive analysis. The results of the statistical analysis indicated that the teaching method integrated with AR applications was a more successful method in promoting students' achievement of Atomic Structure and Atom Models compared to the traditional teaching method. In addition, students with a high level of interest in technology have been more successful in the tests than those with less interested. On the other hand, the data from the ARAAS applied to the experimental group indicated that student attitudes are positive, they are satisfied with using the AR, they do not carry concerns about use and they want to use them in different courses in the future. The experimental group students, through the semi-structured interview form, reported that the AR applications made significant contributions to the educational environment and the teaching process.

***Keywords**:* Augmented Reality, Science Education, Academic Success, Attitude, Atomic Structure, Atomic Models.

* This article was produced from the master's thesis of the first author under the supervision of the second author

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Introduction

Today, learning environments that affect the quality of teaching are pretty important for students to access information easily and be effective in the learning process. Properly structured educational environments provide students rich learning experiences and enabling them to structure information correctly (Yasar, 1998). Most of the studies put forward in line with the researches emphasized the importance of learning environments on learning and stated that these purpose-designed environments provide effective teaching (Öztürk & Güven, 2012).

Wilson (1996) defined the needed environment as learning environments in order to identify problems and produce permanent solutions by using the available possibilities purposefully. There is a need, to be planned and programmed the learning environment to achieve its purpose, to be used appropriate methods and techniques, to be found the necessary materials (Karaman, 2011). Technology-supported learning environments based on a learner-centered conception are highly effective on students' perception and mental structuring. The development of technology brings along the development of learning environments and education concepts. In this context, the concept of learning environment should not be perceived as a narrow scope limited only to the classroom (Kim, Grabovski & Sharma, 2004).
In student-based teaching processes, with the use of technology, students can more easily understand and make the information they create permanent. In addition, the use of technology in learning environments enhances learning experiences, increases interest and motivation, simplifies complex information, and provides active learning opportunities for students. Therefore, the necessity of using technology in learning environments is an undeniable fact of today (Isman, Baytekin, Balkan, Horzum & Chopper, 2002).
Researches has shown that the use of technology in education and training enables an interactive interaction to make the learner from passive to active. Thus, an easier learning environment is provided by creating an effective learning environment (Garzón, & Acevedo, 2019; Şen, 2001). Augmented Reality (AR) applications are one of the computer-aided applications used in education in recent years and offer rich learning experiences by creating multiple learning environments.

AR can generally be defined as expanding complex three-dimensional (3D) graphics through mobile devices. (Starner, Mann, Rhodes, Levine, Healey, Kirsch, Picard and Pentland, 1997). The AR allows access to rich information content everywhere and enables simultaneous interaction between the physical world and digital objects by providing for a seamless analogy between the real world and the virtual layer (Hwang, Chu, Lin & Tsai, 2011; Novak, Wang & Callaghan, 2012).

AR applications used in learning environments have many benefits for teaching. In general, AR applications facilitate the planning and monitoring of plans in educational environments, offer new and different learning environments to the students, encourage research, enable easy learning, contribute to the socialization by increasing the cooperation among the students (Karal & Abdüsselam, 2015; Talan, Batdı &Yılmaz, 2022; Yılmaz & Batdı, 2016; Yılmaz & Batdı, 2021). AR concretizes abstract objects that cannot be obtained from the real world by rendering them in 3D and helps to make meaningful learning. (Finkelstein, Perkins, Adams, Kohl & Podolefsky, 2005; Shelton & Hedley, 2002; Yuen, Yaoyuneyong & Johnson, 2011). When looking at the content of the curriculum, the science course generally includes abstract subjects that students have difficulty in imagining. Therefore, considering the inadequacies of the factors that increase the quality of learning environments, it is thought that new approaches are needed for students to internalize the subjects. (Yigit & Akdeniz, 2003). The aim of this study is to investigate the effect of AR applications, which is a new approach in education, on the success and attitudes of secondary school students about atomic models that are not visible and which are difficult to understand. In this research, it is aimed that the

students learn both the concept of atom and the models of atom by experiencing and structuring correctly in their minds without leaving the real world. In this context, the research is expected to contribute to the literature on augmented reality and education.

Accordingly, the following research questions are sought an answer;

1) Is there a significant difference between the pre-test and post-test scores, achievement levels of the students in the experimental and control groups?
2) Is there a significant difference between the in the experimental group students' interest in technology and their posttest achievement scores?
3) Which level of the attitude of the students in the experimental group towards AR applications?
4) What are the student' views on the use of Augmented Reality technology in education and its impact on teaching?

Methodology

In this research, a mixed-method in which quantitative and qualitative research methods are used together was used. The aim of the mixed method is to ensure that the data obtained by different methods support each other and to adopt an integrative approach by combining the results obtained with quantitative research with the depth and detail objectives of qualitative research (Yıldırım and Şimşek, 2006).

Sample/Study Group

The sample group of the study consisted of total 205 students from six classes attending a secondary school located in Gaziantep in 2017-2018 academic year. Classes are predetermined. In the study, classes are divided into randomized experimental and control groups (Burak, 2022). Three classes are assigned as the control group and three classes as the experimental group. Experimental group 103; the control group consisted of 102 students.

Data Collection

Atomic models, achievement test, augmented reality and attitude scale were used as data collection tools. In addition, semi-structured interviews were applied to 20 randomly selected students from the experimental group.

While the achievement test on the atomic models of science course was created, the 7th grade science lesson of the 2017-2018 academic year was based on the MEB curriculum. The test, which was developed by the researchers and consisting of 23 questions, was examined holistically by experts and necessary corrections were made. Then, the pilot study was conducted on 61 students from 2 classes at the 8th grade level who had already learned this subject and the reliability coefficient of the test was calculated as Cronbach's Alpha 0,842.

In the study; Augmented Reality Applications Attitude Scale prepared by Küçük, Yılmaz, Baydaş and Göktaş (2014) was used. The sample of this attitude scale consisted of 167 secondary school students from 7 different secondary schools. Augmented Reality Applications Attitude Scale (ARAAS) is a 5-point Likert type, (1: Strongly Disagree, 2: Disagree, 3: Undecided, 4: Agree, 5: Strongly Agree) which has collected under 3 factors (satisfaction with use, anxiety of use, future use desire) and It consists of 15 items. The overall internal consistency coefficient of the scale has calculated as $\alpha = 835$.

After the AR applications, semi-structured interview forms were prepared by the researchers to get the opinions of the students in the experimental group about the program and its use in education. Interviews were conducted with 20 randomly students, selected from the experimental group. The forms consist of a total of 7 open-ended questions. By the feedbacks,

received in line with the views of the academicians, the questions were corrected, the forms took the final state.

Learning Material

The learning material was prepared through the Vuforia program by experts. While preparing the content of the program, the 7th grade MEB book for the 2017-2018 academic year is based on. The program is a marker-based high-level application. The main screen of the learning material is shown in Figure 1.

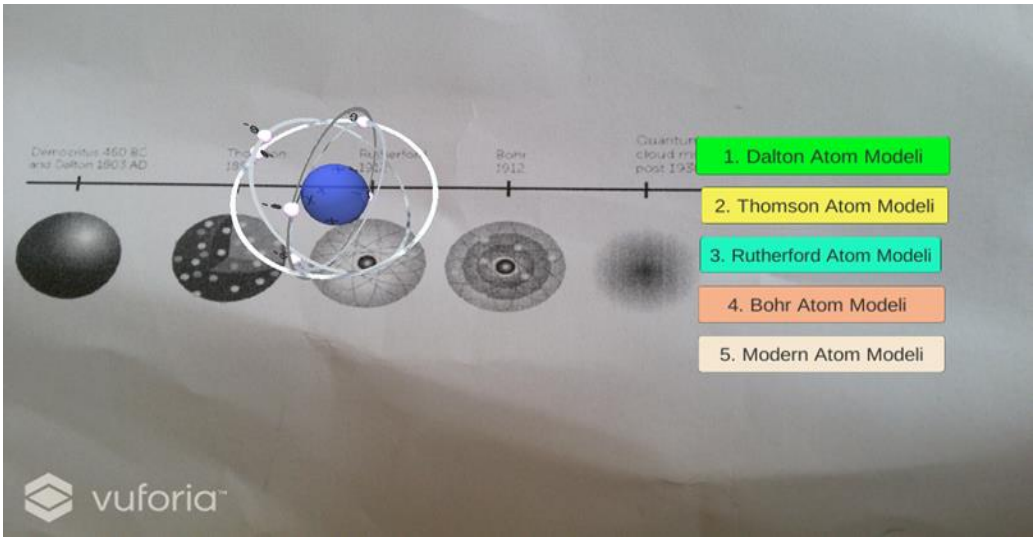

Figure 1. Vuforia program Atom models input screen

Process

In this study, pre-test and post-test design with control group, which is one of the quasi-experimental research models, is used. This pattern is shown in table 1.

Table 1
Pre-test and post-test quasi-experimental design with control group

Group	Pre-test	Application	Post-test
Experimental group	Achievement test	Augmented Reality-based teaching	Achievement test/ AR attitude scale
Control group	Achievement test	Traditional- teaching	Achievement test

Also, by conducting academic achievement and attitude test besides semi-structured interviews aimed students to express their ideas more clearly and concretely about the use of AR in teaching.

Data Analysis

The data obtained from the achievement test were analyzed through SPSS 20 package program. Independent sample t test results were examined on experimental and control groups, and ANOVA and Tukey tests were used to examine the relationship between students' interest level in technology and academic achievement.

The data obtained from the attitude scale were analyzed with SPSS 20 package program. In the study conducted for the students in the experimental group, the average scores for 15 questions in the range total of 15-75 points calculated and evaluations made.

Using the semi-structured interview forms applied to the students, the answers of the students for the questions were examined in detail and codes were formed for each question. The forms, in which these codes passed, were evaluated over frequencies and necessary analyzes made. He information about the analysis of data obtained can be stated in this section.

Findings

Is There a Significant Difference between the Achievement Test Pre-Test Scores of the Students in the Experimental and Control Groups?

In order to determine whether there is a statistically significant difference between the pretesting success scores of the experimental and control groups, an independent group's t-test was performed and the obtained results presented in Table 2.

Table 2
Results of independent group's t-test analysis regarding pretesting achievement scores of experimental and control groups

Group	n	M	SD	t	DF	p
Experimental group	103	14.15	5.05	-.593	202	.554
Control group	102	13.73	5.21			

Levene's test results, obtained after analysis, revealed that group variance could be acceptable as homogeneous. The results of the analysis show that the pre-test mean of the experimental group (M = 14.15, SD = 5.05) and the pre-test mean of the control group (M = 13.73, SD = 5.21) are very close to each other. Independent groups t-test results, which were made to determine that the difference between the pretest mean of the experimental group and the pre-test mean of the control group is not statistically significant, revealed that the difference between the averages was not statistically significant (t (202) = -.593, p> .05). In other words, the analysis' results led to the conclusion that before the procedure, the level of students' knowledge in the experimental and control groups could be considered similar to each other.

Is There a Significant Difference between the Achievement Test Post-Test Scores of the Students in the Experimental and Control Groups?

In order to determine whether there is a statistically significant difference between the post-test achievement scores of the experimental and control groups, independent group's t-test was performed and the obtained results are presented in Table 3.

Table 3
Independent group t-test analysis results of the data, obtained from post-test achievement scores of experimental and control groups

Group	n	M	SD	t	DF	p
Experimental group	103	18.25	3.59	-5.004	203	.000
Control group	102	15.21	4.98			

In order to determine whether there is a significant difference between the groups, t-test results of independent groups were examined and this result showed a significant difference between the control, experimental group and posttest success scores ($t(203) = -5.004$, $p < .05$). So there is a significant difference in favor of the experimental group depending on the method after application. This is a clear indication that AR practices positively affect student achievement compared to the traditional method.

Independent groups "t test" was used to determine whether there is a statistically significant difference between the level of interest in technology and achievement scores of the students in the experimental group and the results obtained are presented in Table 4.

Table 4
One-way variance analysis results to determine whether there is a significant difference in academic achievement scores according to technology interest levels

Level of the interest in technology	n	M	SD	F	p
Less	6	16.00	5.059		
Mid	50	19.02	3.951	3.339	0.039
Much	47	19.93	3.046		

In line with the answers given by the students to this question, it was seen that the average success score of the students who were very interested in technology was the highest ($M = 19.93$), and the average achievement score of the students who had little interest in the technology was the lowest ($M = 16.0$).

Also, a significant difference was found between students' interest in technology and achievement scores ($p < .05$, $F = 3.339$). Complementary calculations were made to determine which groups were between these differences and from post-hoc tests, the Tukey test was used. The statistical result obtained from this test is given in Table 5.

Table 5
Tukey HSD test results showing the relationship between students' level of interest in technology and academic achievement scores

Level of interest in technology		Mean Difference	SE	p
Less	Mid	-3.20	1.569	.137
	Much	-3.936	1.574	.037
Mid	Much	-0.916	0.738	.432

According to the post-hoc test results, It is seen that there is a significant difference between the students who are very interested in technology and those who are less interested in technology $p < .05$). This shows that students with a less level of interest in technology scored lower than the atomic model success test compared to students with a higher level of interest in technology.

Which Level is the Attitude of the Students in the Experimental Group towards AG Applications?

In order to determine the attitudes of the students in the experimental group towards AR applications, a 15-item "Augmented Reality Applications Attitude Scale" was used. The items were divided into 3 categories and scored according to student responses and descriptive analysis were performed. Firstly, the group averages were calculated on the scale which was evaluated over 75 points. The group average was calculated as 68.94 points.
As a result of factor analysis, the following data were obtained;

1) The averages of "use satisfaction" which consists of 7 positive expressions of students, was calculated as 4.5823 out of 5 points. This clearly shows that students are pleased with the course performed by AR application, and using this technology.
2) The averages of "use anxiety" which consists of 6 negative expressions of students, was calculated as 1.4095 out of 5 points. As these expressions were negative, students gave low scores to these expressions on a 5-degree scale and showed that they were not concerned about using AR applications in the course.
3) The averages of "future use desire" which consists of 2 positive expressions the students, was calculated as 4.6285 out of 5 points. This average is a clear indication that students want to use AR applications in the future and other courses too.

What is The Impression on Students in the Use of Augmented Reality Technology in Education and Its Impact on Teaching?

After the procedure, a semi-structured interview form consisting of 7 questions was applied to 20 students to enable students to express their feelings and thoughts against AR technology in more detail. As a result of these questions, students stated the advantages of AR applications in Table 6.

Table 6
Advantages of Augmented Reality applications

Advantages	**Frequencies (f)**
Makes subjects better understood	5
Lessons lapse more fun and enjoyable	6
Information become more permanent	5
Embodies abstract concepts	3
Lessons are easier to understand	5
Topics are processed faster	1
Awakens excitement and curiosity to school	1
Lessons are performed more realistically	1

Ö16 explained the advantages and disadvantages of AR applications as follows: "*If the advantage is used correctly, it can be very high quality works, because we see visually, the information becomes more permanent and we never forget it. We can open and examine in the time we forget by enlarging and shrinking. The disadvantage is that if the teacher releases the students if the program is used for entertainment, it can create chaos in the classroom.*" The answer "There is no one-to-one interaction with the teacher," which is given by a student, draws

attention to the question of the disadvantages of AR applications. The disadvantages of AR applications are given in Table 7 according to the students' statements.

Table 7
Disadvantages of Augmented Reality applications

Disadvantages	**Frequency(f)**
Students can disrupt the lesson	10
Does not provide one-to-one interaction with the teacher	1
In the classroom, chaos may be created and may be spoke in class	4
Don't effect	5

What are the disadvantages of AR applications? The fact that the majority of the students answered the question as "can disrupt the lesson" shows that the students are concerned about this issue. Also, another close answer to this is " it is spoken in class and creates chaos in the classroom" discourse. This shows that the students are concerned about talking in class. The answer "There is no one-to-one interaction with the teacher," which is given by a student, draws attention to the question of the disadvantages of AR applications. The student states that these practices limit teacher-student communication and explains this as a disadvantage. The students expressed the contribution of augmented reality applications in the learning environments as in figure 2.

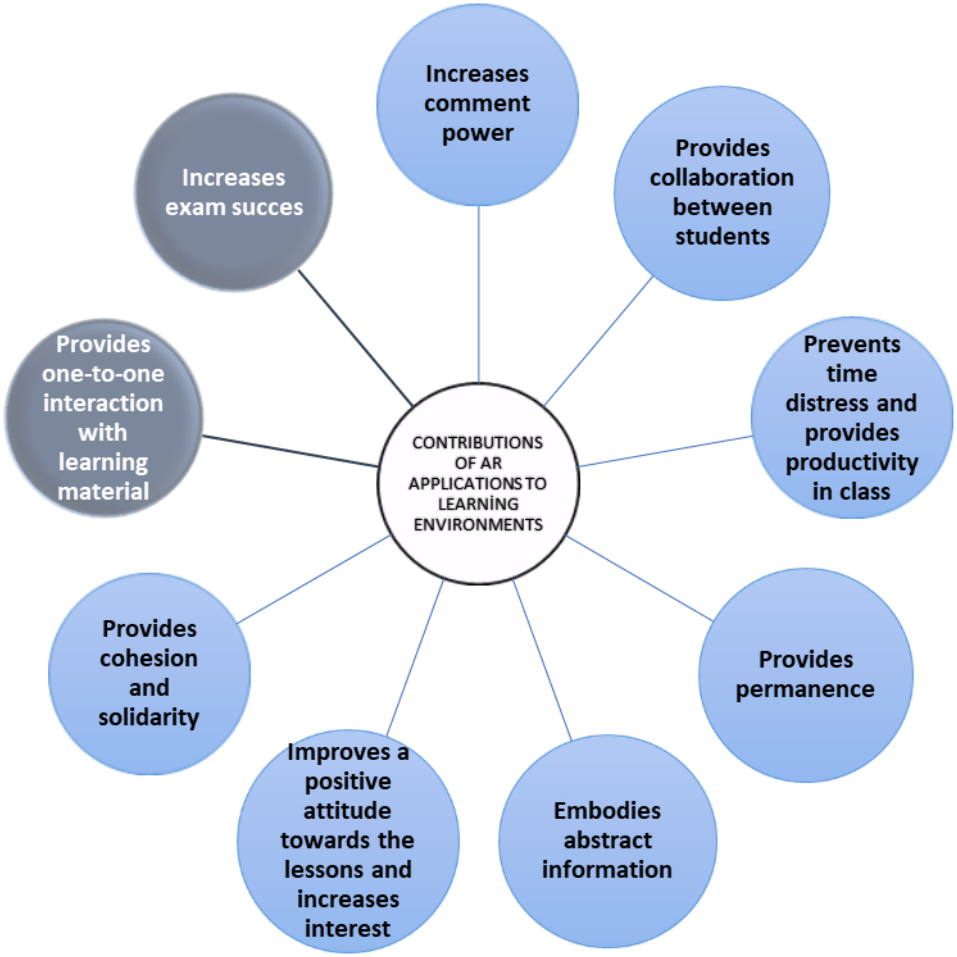

Figure 2. The contribution of augmented reality applications to learning environments

In addition to all these, the students expressed that they generally enjoyed the method of teaching, they had the opportunity to learn by doing and experiencing, and they wanted to use AR applications in other courses and subjects

Discussion / Conclusions and Suggestions

AR applications in formal education have the potential to be an important component in the learning environments of the future. Secondary school students, in science teaching, were pleased to use the application, especially because it offers multiple environments and addresses multiple senses in students. Besides, the data obtained from the attitude test shows that the students do not concern about using the application, and they want to use it in the future and other courses. AR attracts attention, increases desire and curiosity, enables students to enjoy the lesson, and as a result of them, students pay attention to the lessons and work more. These are the other results obtained.

In this study, the results obtained from the achievement tests show that AR applications positively affect student achievement (Abdüsselam & Karal, 2012; İbili and Şahin, 2013; İspir, Okumuş, Küçük & Yıldız, 2024; Shelton and Hedley, 2002; Vilkoniene, 2009). The success of the students on atom in the experimental group, showed clearly that AR applications provide meaningful and in-depth learning by attracting attention and interest to the subjects of science lessons which are especially difficult to understand (Kerawalla et al., 2006). In thislearnings, the fact that students see objects as if they are moving at the same time and see them live; that is, the close relationship between virtual and real objects is also a significant factor (Billinghurst, 2002; Küçük, Turan, Özkan, Taş, & Gürsoy2024; Wojciechowski & Cellary, 2013). Also, the AR applications' prevent concept confusion for subatomic particles (protons, neutrons, electrons) and facilitate concept teaching are other results obtained (Yen, Tsai & Wang, 2012).

As a result of the blending of subjects with AR applications, it is seen that the interests and desires of the students increased (Kerawalla et al., 2006; Rizov & Rizova, 2015; Yusoff & Dahlan, 2013). In addition, AR applications are influential in differentiating information as it provides learning by doing and experiencing (Dunleavy et al., 2009; Erbaş, 2016; Lin et al.,2011). Thanks to this application, students' curiosity and attention towards the lessons is increasing. As a result of this, students have a positive attitude towards AR applications and want to use the application in other classes too.

As a result of the studies, the contribution of AR technology to education seen today. Moreover, it is thought that it will contribute to education not only today but also in the future (Cheng & Tsai, 2012). The use of AR applications, especially in education, and the discovery of its potential, is very important both in terms of country education policies and country productivity. These applications, "How can it be used optimally in the school environment?" answering this question, integrating education is an important step in the transition between the real and virtual world (Billinghurst, 2002). This step is one of the top foundations that should be taken for the steady increase of student achievement and thus the quality of education. In order to realize the importance of these applications in education and to spread the usage area rather than prototype studies, educational researchers have a great responsibility.

Limitations and Recommendations

This study is limited to 205 seventh grade students in a province in the Southeast of Turkey. Since the subject of atomic models is available at different levels of education, it can be applied to different high school and university students.

Conflict of Interest: The authors declare that they have no conflict of interest.

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Research Article
Received: 24.11.2024
Accepted: 30.12.2024
Published: 31.12.2024

Citation: Toprak, E., & Kızılok Kara, E. (2024). Statistical analysis of educational data using copula functions: The case of 2018 PISA. *International Journal of Scholars in Education, 7*(2), 169-184. https://doi.org/10.52134/ueader.1590602

Statistical Analysis of Educational Data Using Copula Functions: The Case of 2018 PISA*

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***Abstract*:** In this study, using 2018 PISA data, the dependency structures between mathematics, science, and reading scores were analyzed with elliptic and archimedean copula functions according to the factors of gender and educational level at home. PISA is an international assessment that measures the education levels of students in science, mathematics, and reading and aims to compare education levels among countries. Copula functions are statistical tools that allow flexible modeling of dependency relationships between variables and provide the most appropriate way of obtaining multivariate distributions. In this study, firstly, models were constructed for data pairs consisting of PISA maths, reading, and science scores according to home education level and gender factors. Then, the copula models that best explain these structures were determined by goodness-of-fit tests, and the copula parameters for the selected models were estimated. Finally, joint and conditional probabilities were calculated for these score pairs in order to evaluate the effect of reading scores on maths and science courses. The study emphasizes the potential use of copula models in educational research and provides new findings on the impact of gender and home education level on PISA performances.
***Keywords**:* Dependency, Copula, Conditional probability, Joint probability, PISA achievement scores.

Kopula Fonksiyonları ile Eğitim Verilerinin İstatistiksel Analizi: 2018 PISA Örneği

Öz: Bu çalışmada, 2018 PISA verileri kullanılarak matematik, fen ve okuma puanları arasındaki bağımlılık yapıları, cinsiyet ve evdeki eğitim düzeyi faktörlerine göre eliptik ve arşimedyan kopula fonksiyonlarıyla analiz edilmiştir. PISA, fen, matematik ve okuma alanlarında öğrencilerin eğitim seviyelerini ölçen ve ülkeler arasındaki eğitim düzeylerini karşılaştırmayı amaçlayan uluslararası bir değerlendirmedir. Kopula fonksiyonları ise değişkenler arasındaki bağımlılık ilişkilerini esnek bir şekilde modellemeye olanak tanıyan ve çok değişkenli dağılımların en uygun biçimde elde edilmesini sağlayan istatistiksel araçlardır. Çalışmada, ilk olarak evdeki eğitim düzeyi ve cinsiyet faktörlerine göre PISA matematik, okuma ve fen puanlarından oluşan veri çiftleri için modeller oluşturulmuştur. Daha sonra, bu yapıları en iyi açıklayan kopula modelleri, uyum iyiliği testleri ile belirlenmiş ve seçilen modellere ilişkin kopula parametreleri tahmin edilmiştir. Son olarak, okuma puanının matematik ve fen dersleri üzerindeki etkisini değerlendirebilmek amacıyla bu puan çiftleri için ortak olasılıklar ile koşullu olasılıklar hesaplanmıştır. Çalışma, kopula modellerinin eğitim araştırmalarındaki potansiyel kullanımını vurgulayarak cinsiyet ve evdeki eğitim düzeyinin PISA performansları üzerindeki etkilerine ilişkin yeni bulgular sunmaktadır.
***Keywords**:* Bağımlılık, Kopula, Koşullu olasılık, Ortak olasılık, PISA başarı puanları.

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* This study was produced from the master's thesis prepared by the first author under the supervision of the second author.

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Introduction

PISA, which was first implemented in 2000 and has been implemented every three years to date, and in which Turkey first participated in 2003, is an important international project that allows all participating countries to evaluate their education systems. "Policy makers around the world use PISA results to compare the knowledge and skill levels of students in their own countries with the knowledge and skill levels of students in other countries participating in the project, to set standards for raising the level of education (e.g. average scores achieved by countries, educational outcomes of countries and their capacity to ensure the highest level of equality in educational opportunities) and to identify the strengths and weaknesses of education systems (MEB, 2013; Toprak, 2017). In addition to revealing the status of countries in the measured areas, PISA results also identify periodic progress, regression or stagnation thanks to the fact that the application is carried out every three years. PISA applications conducted by the Organization for Economic Cooperation and Development (OECD) also provide detailed tables comparing the economic development of countries with their educational status (OECD, 2014). Considering the importance that countries attach to PISA applications in order to see their status in the field of education and, accordingly, to correct their deficiencies, examining PISA achievements, which are extremely critical, emerges as an important problem situation. At this point, the subject of the study was determined to examine the relationships between PISA science, mathematics and reading achievements in terms of different variables.

The copula method will be used to model the dependency structures between PISA science, mathematics and reading achievements. Copula is a probabilistic modeling method that is frequently used to model the dependence of multivariate data in fields such as finance, economics and actuarial science. Copulas allow to model the dependence structure of the joint distribution independently of the marginal distributions. It can also explain the dependence structure between variables when the marginals are not normally distributed.

Copula models provide a wide range of applications in different fields such as financial data analysis (Patton, 2013; Kizilok Kara et al. 2022; Kara and Kemaloglu, 2016), hydrology (Favre et al. 2004; Genest and Favre 2007; Kizilok Kara and Yildiz, 2014, Baykal, 2024) and environmental data modeling (Goda 2010; Kwon and Yoon 2017; Kizilok Kara 2017; Bhatti and Do 2019; Nguyen-Huy, 2019), allowing the examination of dependency structures. However, as a result of the research, although there are studies using PISA data in Turkey (Anıl 2009; Kasap et al. 2021; Sarıer 2021), a limited number of studies have been identified in which the dependency structure between achievement scores is modeled with the copula method. The most recent study in this field was conducted by Pala and Sağlam (2019) for 2006-2015 PISA data and does not include an evaluation by demographic characteristics.

The aim of this study is to analyze the dependency structures between math, reading and science scores according to variables such as gender and level of education at home with the help of copula functions using 2018 PISA (URL-1) data. The most appropriate copula functions for each demographic group were determined by goodness-of-fit tests. Both joint and conditional probabilities were calculated through these copula functions, with a particular focus on the probability of students having above average achievement scores. By using up-to-date data and evaluating dependency structures based on demographic variables, the study aims to make a new methodological contribution to the literature.

Elliptical (Gaussian and t-copula) and archimedean (Clayton, Frank, Gumbel and Joe) copula families are used throughout the study. Maximum Pseudo-Likelihood Estimation (MPLE) method is used to estimate the copula parameters. Akaike Information Criterion (AIC), Bayes Information Criterion (BIC), Log-Likelihood Function (LL), and Cramer von Mises (CvM) values were used for goodness-of-fit tests and model selection. The analyses are performed with

the 'copula' package in R software written by Hofert et al. (2024) and we refer to key literature sources such as Cherubini et al. (2004), Joe (2014), Nelsen (2006) and Emrechet (2003).

The findings of this study provide an important resource for the formulation of educational policies based on PISA results. Revealing different dependency structures according to demographic variables can contribute to the efforts to provide equal opportunities in education and to shape policies for student achievement.

In the rest of the study, firstly, copula, joint and conditional probability definitions according to copula, elliptic and archimedean copula functions, parameter estimation and model selection are introduced. Then, the models based on PISA data and demographic variables are described. Descriptive statistics, correlation and symmetricity test results of the models are presented. Then, the best copula models selected for the models according to the goodness-of-fit test results and the copula analysis results including parameter estimates are presented. Finally, some joint and conditional probabilities are calculated. The study is concluded with the conclusion section.

Materials and Methods

In this section, the copula, some copula functions, joint probabilities and conditional probabilities according to copula, parameter estimation, goodness of fit tests and model selection criteria are introduced.

Copula Theory

Copulas are mathematical tools used to model the dependence structure between multivariate distributions. They offer the possibility to analyze non-linear dependencies without requiring any assumptions about marginal distributions. Copulas create reliable models even when the data is not normally distributed and provide the flexibility to accurately reflect dependence under different marginal distributions. Thanks to these properties and the ability to calculate joint and conditional probabilities, copulas have a wide range of applications in areas such as finance, insurance, risk management and actuaries.

Copulas are defined by Sklar's Theorem introduced by Sklar (1959). According to this theorem, for a continuous random vector (X, Y) with marginals F and G, two-dimensional joint distribution function $H(x, y)$ is defined with only a copula $C : [0,1]^2 \rightarrow [0,1]$.

$$H(x, y) = P(X \leq x, Y \leq y) = C(F(x), G(y)) \quad (1)$$

On the other hand, the joint survival function $\bar{H}(x, y) = P(X > x, Y > y)$ depending on the copula is defined as

$$\bar{H}(x, y) = \bar{F}(x) + \bar{G}(y) - 1 + C\left(1 - \bar{F}(x), 1 - \bar{G}(y)\right) \quad (2)$$

Here $\bar{F}$ and $\bar{G}$ are the marginal survival functions of the random variables X, and Y, respectively.

On the other hand, conditional probabilities can be defined using joint probability information C and $\bar{C}$ with the marginals F, and G. The conditional probabilities used in the study are given below.

$P(\mathrm{X} > \mathrm{x}|\mathrm{Y} > \mathrm{y})$: The probability that Y the variable is above a certain value, given that X the variable is above a certain value:

$$P(X > x|Y > y) = \frac{P(X>x, Y>y)}{P(Y>y)} = \frac{\bar{H}(x,y)}{\bar{G}(y)} \quad (3)$$

$P(Y > y|X > x)$: The probability that X the variable is above a certain value, given that Y the variable is above a certain value:

$$P(Y > y|X > x) = \frac{P(X>x,Y>y)}{P(X>x)} = \frac{\bar{H}(x,y)}{\bar{F}(y)} \quad (4)$$

When the marginal distributions $U(0,1)$ are uniformly distributed, the copula $C(u,v)$ and the copula-based the joint survival function $\bar{C}(u,v)$ with transformations $F(x) = U$ and $G(y) = V$, respectively, are defined as follows (Nelsen, 2006):

$$C(u,v) = P(U \leq u, V \leq v) = H(F^{-1}(u), G^{-1}(v)) \quad (5)$$

$$\bar{C}(u,v) = P(U > u, V > v) = 1 - u - v + C(u,v) \quad (6)$$

The conditional probabilities according to the copula $C(u,v)$ and the joint life function $\bar{C}(u,v)$ are given below:

If we denote by $\bar{C}_v(u)$ the probability that U is above a certain value when V is known to be above a certain value, and similarly, if we denote by $\bar{C}_u(v)$ the probability that V is above a certain value when U is known to be above a certain value, these conditional probabilities can be defined as follows, respectively.

$$\bar{C}_v(u) = P(U > u|V > v) = \frac{P(U>u,V>v)}{P(V>v)} = \frac{\bar{C}(u,v)}{\bar{G}(v)} \quad (7)$$

$$\bar{C}_u(v) = P(V > v|U > u) = \frac{P(U>u,V>v)}{P(U>u)} = \frac{\bar{C}(u,v)}{\bar{F}(u)} \quad (8)$$

Copulas are classified into several families to model dependency structures in different ways, the most well-known being elliptic and archimedean. copulas. Elliptical copulas (Gaussian and t) are known for their ability to model symmetric dependencies, while archimedean copulas (Clayton, Frank, Gumbel, and Joe) offer flexible dependency structures. The Frank copula offers a symmetric structure that models upper and lower tail dependence, while the Clayton copula has an asymmetric structure, and models negative left tail dependence. The Gumbel copula is asymmetric and is mostly used to model positive right tail dependence. The Joe copula is a copula that models positive dependencies and right tail dependencies (Cherubini et al. 2004, Joe 2014, Nelsen 2006, Embrechts et al. 2003). The mathematical functions for these copulas are given below:

Gaussian copula:

$$C_\theta(u,v) = \int_{-\infty}^{\phi^{-1}(u)} \int_{-\infty}^{\phi^{-1}(v)} \frac{1}{2\pi\sqrt{1-\theta^2}} exp\left(-\frac{s^2 - 2\theta st + s^2}{2(1-\theta^2)}\right) dsdt\,, \qquad \theta \in [0,1]$$

t copula:

$$C_\theta(u,v) = \int_{-\infty}^{t_v^{-1}(u)} \int_{-\infty}^{\phi_v^{-1}(v)} \frac{1}{2\pi\sqrt{1-\theta^2}} exp\left(-\left(1 + \frac{s^2 - 2\theta st + t^2}{v(1-\theta^2)}\right)\right) dsdt\,, -1 < \theta < 1, v > 2$$

Clayton copula:

$$C_\theta(u,v) = \left[max\left(u^{-\theta} + v^{-\theta} - 1; 0\right)\right]^{-1/\theta}, \ \theta \in [-1,\infty) \setminus \{0\}$$

Frank copula:

$$C_\theta(u,v) = -\frac{1}{\theta} ln\left(1 + \frac{(e^{-\theta u} - 1)(e^{-\theta v} - 1)}{e^{-\theta} - 1}\right), \ \theta \neq 0$$

Gumbel copula:

$$C_\theta(u,v) = exp\left(-\left[(-logu)^\theta + (-logv)^\theta\right]^{1/\theta}\right), \qquad \theta \in [1,\infty)$$

Joe copula:

$$C_\theta(u,v) = 1 - ((1-u)^\theta + (1-v)^\theta - (1-u)^\theta(1-v)^\theta)^{(\frac{1}{\theta})}, \qquad \theta \in [1,\infty)$$

***Parameter Estimation*:** Parametric and nonparametric methods are used for copula parameter estimation. Among parametric methods, maximum likelihood estimation (MLE) estimates the parameters of the copula and marginal distributions simultaneously, while the

inference function of marginals (IFM) method performs these estimates in two steps: in the first step, the marginal distribution parameters of each variable are estimated independently; in the second step, the parameters of the copula function are estimated using these marginal distributions (Joe and Xu, 1996). Among nonparametric methods, the canonical maximum likelihood (CML) method does not directly estimate marginal distributions but instead estimates copula parameters using empirical distribution functions (Cherubini et al., 2004). The maximum pseudo-likelihood estimation method (MPLE) is a simple and widely used approach that estimates copula parameters using pseudo-observations generated based on the ordering of the data without using empirical distribution functions (Shih and Louis, 1995; Genest et al. 1995).

In this study, the pseudo maximum likelihood estimation (MPLE) method expressed by equation (9) with respect to the copula density function $c(u_i, v_i; \theta)$ is used for parameter estimation.

$$\hat{\theta} = arg\max_{\theta} \ell(\theta) = arg\max_{\theta} \sum_{i=1}^{n} log\, c\,(u_i, v_i; \theta) \quad (9)$$

The pseudo-observations are calculated by $u_i = r_i\,/(n+1)$ and $v_i = s\,/(n+1)$. Here $r_i = Rank(x_i)$ and $s_i = Rank(y_i)$ are the ranks of observations, n is the number of observations. Parameter estimation was performed with the MPLE method using the 'fitCopula' function in the "copula" package of the R program (Hofert et al., 2024).

Goodness-of-fit Tests: A goodness-of-fit test is a statistical method used to assess how well a model fits the observed data. This test measures the fit of the model to the data by analyzing the differences between the observed and expected distributions from the model. If the probability distribution of the population is unknown, it may be difficult to accurately represent the population with a traditional probability distribution. Therefore, it is a logical approach to select an appropriate distribution using a large amount of information through various techniques (Shin et al., 2010).

In this context, KS (Kolmogorov-Smirnov), CvM (Cramer-von Mises) and AD (Anderson Darling) tests are widely used. In this study, the CvM test, one of the goodness of fit tests, was used and the gofCopula test of the "copula" package in the R program implemented with the function (Hofert et al., 2024).

The CvM test is a method that measures the fit between two distributions by evaluating the sum of the squares of the differences between the observed and theoretical distribution functions. To obtain the CvM test statistic, $\{(x_i, y_i)\}_{i=1}^{n}$, the data set is first arranged in order of magnitude. Marginal distributions $F_X(x)$and $F_Y(y)$ empirically estimated and $u_i = \hat{F}_X(x_i), \quad v_i = \hat{F}_Y(y_i), \; i = 1,2,\dots,n$ so-called pseudo-observations are created.

The CvM test statistic is calculated by integrating the squares of the differences between the empirical copula function $\hat{C}_n(u, v)$ and the theoretical copula function, $C\left(u, v; \hat{\theta}\right)$ obtained for the pseudo-observations (u_i, v_i) over the entire data set, with the formula $W^2 = n\int_0^1\int_0^1 \left(C_n(u,v) - C(u,v;\theta)\right)^2 dC(u,v;\theta)$. However, since it is usually difficult to calculate in closed form, the following approximate formula is used for n observations:

$$W^2 = n \cdot \frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n}\left(\hat{C}_n(u_i, v_j) - C\left(u_i, v_j; \hat{\theta}\right)\right)^2 \quad (10)$$

Model Selection: Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) are widely used in the literature to determine the most appropriate copula model for the data. In addition, the Copula Information Criterion (CIC) developed by Grønneberg et al. (2014) based on the k-fold cross-validation method is used to select the most appropriate copula

model (Kwon and Yoon, 2017). The model with the lowest AIC and BIC values or the highest CIC value is considered the best fit to the data.

In this study, AIC, BIC and CIC criteria were used for the selection of copula models. In the model selection process, the calculation methods of each criterion defined by Akaike (1974), Schwarz (1978) and Grønneberg et al. (2014) are given below, respectively:

$$AIC = -2\mathcal{L} + 2k \tag{11}$$

$$BIC = -2\mathcal{L} + k \log n \tag{12}$$

Here, $\mathcal{L}$ represents the log likelihood value calculated by $\mathcal{L} = \sum_{i=1}^{n} log\ c(u_i, v_i, \hat{\theta})$, k represents the number of parameters in the model, and n represents the sample size.

CIC is the most appropriate copula selection method calculated using the k-fold cross-validation method. In this method, the data set is divided into k equal-sized subsets. Each layer is used as the test set in turn, while the remaining $k-1$ layer is used as the training set. The copula model is trained on the training set and the log likelihood value is calculated on the test set. The CIC value is obtained by averaging the log likelihood values obtained for all layers:

$$CIC = -2 \cdot \frac{1}{k} \sum_{j=1}^{k} \mathcal{L}_j + \gamma(\hat{\theta}) \tag{13}$$

Here, $\mathcal{L}_j$ represents the maximum likelihood value calculated for each layer, and $\gamma(\hat{\theta})$ represents the penalty term depending on the complexity of the model. In our study, these calculations were made using the fitCopula (for AIC and BIC) and xvCopula (for CIC) functions of the "copula" package in the R program (Hofert et al., 2024).

PISA Dataset and Models

In the study, the 2018 PISA data from (URL-1) which includes the Mathematics, Reading and Science achievement scores of male and female students classified according to their home education levels, were used. Educational opportunities at home include parental education level, parental involvement in homework, and physical resources for homework. These physical resources can be concretized as the student's own room, books, computer, and internet connection. In addition, the family's level of education, occupation and support for the student can be mentioned as examples of intangible resources. All these resources are expressed by the index of educational opportunities at home. In the current study, the level of educational opportunities at home was analyzed through three subgroups. For example, 2018 PISA data are grouped into the following index ranges:

- Low level group; -4.75 / -2.25
- Intermediate group; -2.24 / 0.25
- High level group; 0.26 / 2.76

For data pairs consisting of PISA mathematics, reading and science scores (1: Mathematics-Reading, 2: Mathematics-Science, 3: Reading-Science), models were created according to variables such as home education levels (1: Low, 2: Medium, 3: High) and gender (M: Male, F: Female) and these model definitions are given in Table 1. Descriptive statistics for each model are presented in Table 2 for male and female students. Table 3 shows the Pearson, Spearman and Kendall correlation values and the symmetry test results. Marginal distribution goodness of fit tests was performed for the mathematics, reading and science variables in each model and the results for male and female students are presented in Tables 4 and 5, respectively.

Table 1
Model definitions

Gender	Education Level	Couple	Model
Male	Low	Math-Reading	Model M11
		Math-Science	Model M12
		Reading-Science	Model M13
	Middle	Math-Reading	Model M21
		Math-Science	Model M22
		Reading-Science	Model M23
	High	Math-Reading	Model M31
		Math-Science	Model M32
		Reading-Science	Model M33
Female	Low	Math-Reading	Model F11
		Math-Science	Model F12
		Reading-Science	Model F13
	Middle	Math-Reading	Model F21
		Math-Science	Model F22
		Reading-Science	Model F23
	High	Math-Reading	Model F31
		Math-Science	Model F32
		Reading-Science	Model F33

Table 2 presents the descriptive statistics of male and female students' math, reading and science achievement by gender and educational level. In general, for both genders, it was observed that achievement averages increased as the level of education increased. While the distribution of achievement was generally symmetrical for male students at lower levels of education, the distribution of achievement was skewed to the right for female students, especially at lower levels of education, meaning that higher achievements were observed less frequently. Female students have higher averages than male students in reading and science achievement at all levels of education, and skewness and kurtosis values are generally close to symmetry. In addition, it is noteworthy that for both genders, achievements show a more homogeneous distribution as the level of education increases, i.e. the standard deviation decreases.

Table 2
Descriptive statistic

Gender	Education Level	Success	N	Mean	Median	Mode	Std. Deviation	Skewness	Kurtosis
Male	Low	Maths	153	365.3851	376.5970	151.8840	99.2378	-0.0397	-0.5918
		Reading	153	373.6318	366.3450	198.9440	86.9523	0.3074	-0.5166
		Science	153	399.9808	395.8160	218.3790	85.2644	0.1899	-0.3253
	Middle	Maths	1635	446.7775	446.9170	470.1040	84.2605	0.1052	-0.3052
		Reading	1635	441.3712	441.5230	334.9190	85.5481	0.0447	-0.4112
		Science	1635	453.7162	451.1460	345.5830	81.6772	0.1292	-0.3308
	High	Maths	1706	470.5440	467.2435	396.7150	86.8013	0.2305	-0.2555
		Reading	1706	466.5770	464.0395	489.7070	88.7855	0.1343	-0.3960
		Science	1706	476.8362	472.8860	454.6140	84.7532	0.1374	-0.2948
Female	Low	Maths	101	358.3634	360.5450	198.9500	87.9623	0.0004	-0.8263
		Reading	101	399.1779	393.6810	264.3040	71.6977	0.3299	-0.4532
		Science	101	412.4590	398.4060	244.1080	78.4219	0.3445	-0.7898
	Middle	Maths	1700	441.6859	435.2780	389.0830	79.2538	0.3627	0.1074
		Reading	1700	467.9501	465.8625	432.6020	78.8890	0.1209	-0.2779
		Science	1700	461.2697	458.4480	490.3950	76.2567	0.1412	-0.2752
	High	Maths	1595	465.7769	462.6160	385.5930	87.0589	0.1939	-0.1907
		Reading	1595	493.9962	493.5980	412.7390	84.8008	-0.0265	-0.1984

	Science	1595	488.1876	489.7940	417.9890	81.6587	-0.0608	-0.3811

The relationships between male and female students' mathematics, reading and science achievements were analyzed using Pearson, Spearman and Kendall correlation methods and symmetry tests were performed using the ' exchTest ' function in the "copula" package in the R software. According to the results given in Table 3, strong positive relationships were found in both genders. Especially for female students, the relationship between reading and science achievements was found to be quite high. It was observed that the relationships between achievements became stronger as the level of education increased. The p values of all correlation tests were below 0.05 and these relationships were found to be statistically significant. In addition, according to the symmetry test results, the models support the symmetric distribution assumption (p>0.05).

Table 3
Correlation values and symmetry test values

Models	Pearson *	Spearman *	Kendall *	Symmetry Tests (p- value **)
Model M11	0.8280	0.8412	0.6483	0.012218 (0.6798)
Model M12	0.8417	0.8435	0.6488	0.007646 (0.9745)
Model M13	0.8323	0.8435	0.6452	0.018625 (0.2243)
Model M21	0.8094	0.8070	0.6082	0.010212 (0.9316)
Model M22	0.8260	0.8244	0.6271	0.021749 (0.0854)
Model M23	0.8669	0.8684	0.6790	0.015981 (0.1863)
Model M31	0.8191	0.8169	0.6214	0.018632 (0.2133)
Model M32	0.8372	0.8328	0.6379	0.010334 (0.8776)
Model M33	0.8687	0.8639	0.6763	0.008717 (0.9436)
Model F11	0.7947	0.8083	0.6040	0.013136 (0.6748)
Model F12	0.7652	0.7534	0.5489	0.015293 (0.6259)
Model F13	0.8549	0.8545	0.6749	0.020782 (0.1084)
Model F21	0.7975	0.7887	0.5928	0.016194 (0.4201)
Model F22	0.8210	0.8156	0.6185	0.010656 (0.9006)
Model F23	0.8524	0.8480	0.6554	0.010287 (0.8846)
Model F31	0.8191	0.8184	0.6226	0.014972 (0.5230)
Model F32	0.8373	0.8380	0.6442	0.010941 (0.8107)
Model F33	0.8741	0.8696	0.6836	0.018021 (0.0774)

(*) All correlations are significant($p < 0.05$), (**) all models are symmetric ($p > 0.05$).

Table 4, and Table 5 present the goodness of fit results of the marginal distribution for male and female students' achievement. Here, the best-fitting marginal distributions for each category are marked with (*).

Table 4
Marginal distribution goodness of fit results for male students

Education Level	Success	Marginal Distribution	KS	p value	AIC	Par 1	Par 2
Low	Math	Normal	0.0835	0.2361	1844.0327	365.3851	98.9129
		Log-Normal	0.1021	0.0824	1857.1806	5.8603	0.2943
		Gamma	0.0869	0.1983	1849.4386	12.5384	0.0343
		Weibull *	**0.0769**	**0.3260**	**1841.9317**	4.1684	402.5597
	Read	Normal	**0.0540**	**0.7636**	1803.5920	373.6318	86.6677
		Log-Normal	0.0694	0.4535	1800.2014	5.8959	0.2358
		Gamma*	0.0627	0.5846	**1799.1500**	18.7380	0.0501
		Weibull	0.0653	0.5308	1808.4101	4.6584	408.1857
	Science	Normal *	**0.0475**	**0.8804**	1797.5934	399.9808	84.9853
		Log-Normal	0.0616	0.6077	1799.6863	5.9681	0.2190

		Gamma*	0.0581	0.6793	**1796.8978**	21.3366	0.0535
		Weibull	0.0706	0.4303	1802.8045	5.1087	434.4287
Middle	Math	Normal *	**0.0170**	**0.7310**	**19141.8254**	446.7775	84.2347
		Log-Normal	0.0428	0.0050	19180.9615	6.0836	0.1944
		Gamma	0.0327	0.0601	19149.8782	27.1391	0.0608
		Weibull	0.0401	0.0105	19203.0397	5.7729	481.6767
	Read	Normal *	**0.0192**	**0.5811**	**19191.4163**	441.3712	85.5219
		Log-Normal	0.0425	0.0054	19254.4915	6.0702	0.2015
		Gamma	0.0316	0.0763	19213.5396	25.6945	0.0581
		Weibull	0.0319	0.0715	19230.8552	5.6932	476.5935
	Science	Normal *	**0.0279**	**0.1576**	**19040.0030**	453.7162	81.6522
		Log-Normal	0.0293	0.1208	19069.4545	6.1008	0.1846
		Gamma	0.0806	0.0000	19258.5373	48.2940	0.1062
		Weibull	0.0406	0.0090	19112.4624	6.0264	487.9299
High	Math	Normal	0.0243	0.2643	20074.2931	470.5440	86.7758
		Log-Normal	0.0268	0.1732	20073.2200	6.1366	0.1876
		Gamma *	**0.0165**	**0.7410**	**20055.7739**	28.7082	0.0611
		Weibull	0.0464	0.0013	20171.7918	5.7964	506.8684
	Read	Normal *	**0.0260**	**0.1975**	**20151.4134**	466.5770	88.7595
		Log-Normal	0.0304	0.0856	20181.6387	6.1267	0.1955
		Gamma	0.0804	0.0000	20427.1537	45.1324	0.0967
		Weibull	0.0439	0.0028	20216.3691	5.7242	503.4106
	Science	Normal *	**0.0259**	**0.2015**	**19992.8236**	476.8362	84.7284
		Log-Normal	0.0268	0.1733	20020.3232	6.1509	0.1821
		Gamma	0.0666	0.0000	20216.8212	49.5142	0.1039
		Weibull	0.0440	0.0027	20073.8805	6.0859	512.4590

Table 5
Marginal distribution goodness of fit results for female students

Education Level	Success	Marginal Distribution	KS	p value	AIC	Par 1	Par2
Low	Math	Normal	0.0986	0.2797	1193.9560	358.3634	87.5257
		Log-Normal	0.1039	0.2256	1198.0386	5.8497	0.2573
		Gamma	0.0994	0.2710	1195.2476	15.4475	0.0431
		Weibull *	**0.0902**	**0.3835**	**1193.0293**	4.6249	392.4949
	Read	Normal	0.0837	0.4781	1152.6573	399.1779	71.3419
		Log-Normal *	**0.0482**	**0.9730**	**1149.9515**	5.9734	0.1792
		Gamma	0.0575	0.8924	1149.9803	31.1312	0.0781
		Weibull	0.1062	0.2046	1159.4555	5.9500	429.4407
	Science	Normal	0.1385	0.0414	1170.7654	412.4590	78.0327
		Log-Normal *	**0.1118**	**0.1603**	**1166.7381**	6.0043	0.1888
		Gamma	0.1200	0.1090	1167.2267	28.3195	0.0687
		Weibull	0.1415	0.0350	1176.3761	5.6768	445.2812
Middle	Math	Normal	0.0359	0.0253	19694.4179	441.6859	79.2305
		Log-Normal *	**0.0147**	**0.8536**	**19660.1867**	6.0745	0.1805
		Gamma	0.0542	0.0001	19788.1485	45.1288	0.1021
		Weibull	0.0585	0.0000	19839.7410	5.7899	475.1238
	Read	Normal *	**0.0196**	**0.5339**	**19678.7320**	467.9501	78.8658
		Log-Normal	0.0287	0.1221	19706.3077	6.1338	0.1724
		Gamma	0.0514	0.0003	19777.1576	47.2835	0.1010
		Weibull	0.0438	0.0029	19764.9994	6.4092	501.4310
	Science	Normal *	**0.0224**	**0.3607**	**19563.3487**	461.2697	76.2343
		Log-Normal	0.0251	0.2325	19581.8719	6.1200	0.1685
		Gamma	0.0575	0.0000	19674.4995	50.6932	0.1098

		Weibull	0.0496	0.0005	19658.6931	6.5032	493.7424
High	Math	Normal	0.0223	0.4086	18777.8205	465.7769	87.0316
		Log-Normal	0.0283	0.1540	18792.2675	6.1258	0.1911
		Gamma *	**0.0204**	**0.5235**	**18769.9071**	28.3919	0.0611
		Weibull	0.0427	0.0059	18861.8263	5.7373	502.0037
	Read	Normal *	**0.0181**	**0.6715**	**18693.9868**	493.9962	84.7742
		Log-Normal	0.0419	0.0074	18769.8000	6.1871	0.1785
		Gamma	0.0298	0.1186	18728.3738	32.8852	0.0665
		Weibull	0.0338	0.0528	18739.6598	6.4171	529.5292
	Science	Normal *	**0.0191**	**0.6028**	**18573.5433**	488.1876	81.6331
		Log-Normal	0.0445	0.0036	18647.5229	6.1761	0.1737
		Gamma	0.0346	0.0442	18608.4186	34.5749	0.0708
		Weibull	0.0324	0.0709	18603.9610	6.6643	522.6050

Copula Analysis of PISA Data

In this part of the study, it was aimed to determine the joint distribution functions of the dependency structures of 2018 PISA mathematics, reading and science scores according to demographic variables such as gender and education level at home by using copula functions for each model created in Table 1. Appropriate copula selections were made by considering the smallest Cramer von Mises (CvM), smallest AIC, BIC and largest CIC values and the results are given in Table 6. Here, the best-fitting copulas for each model are marked with (*).

Table 6
Selection of the best copula model.

		Goodness of Fit Test		Information Criteria		
Model	Copula	CvM	p value	AIC	BIC	CIC
Model M11	Normal	0.0309	0.0235	-160.5268	-157.4964	78.6394
	t	0.0347	0.0125	-160.0805	-157.0500	77.3422
	Clayton	0.0759	0.0005	-101.7045	-98.6741	8.9800
	Frank*	**0.0167**	0.2223	**-173.6919**	**-170.6615**	**84.7366**
	Gumbel	0.0354	0.0235	-160.6966	-157.6661	79.1489
	Joe	0.1283	0.0005	-138.0549	-135.0245	61.8950
Model M12	Normal*	**0.0143**	0.4461	**-177.0821**	**-174.0517**	**87.4671**
	t	0.0282	0.0395	-165.0112	-161.9808	77.2770
	Clayton	0.0528	0.0085	-113.5975	-110.5670	24.5576
	Frank	0.0162	0.2702	-176.3328	-173.3024	84.9246
	Gumbel	0.0305	0.0385	-167.5535	-164.5230	78.9948
	Joe	0.1303	0.0005	-139.6985	-136.6681	64.6237
Model M13	Normal	0.0378	0.0115	-162.0242	-158.9937	78.4387
	t	0.0494	0.0015	-157.1345	-154.1040	76.5346
	Clayton	0.0911	0.0005	-96.2035	-93.1731	2.0860
	Frank*	**0.0207**	0.1204	**-171.3872**	**-168.3567**	**86.0487**
	Gumbel	0.0328	0.0355	-166.7235	-163.6931	82.6460
	Joe	0.0916	0.0005	-149.1639	-146.1335	72.6009
Model M21	Normal*	**0.0319**	0.0225	**-1704.2463**	**-1698.8469**	**846.9480**
	t	0.1139	0.0005	-1612.1597	-1606.7603	803.9543
	Clayton	0.5274	0.0005	-1154.9323	-1149.5329	359.7287
	Frank	0.0631	0.0005	-1632.4727	-1627.0733	814.6000
	Gumbel	0.1345	0.0005	-1603.3696	-1597.9702	799.0946
	Joe	0.9881	0.0005	-1313.1456	-1307.7462	649.9319
Model M22	Normal*	**0.0436**	0.0035	**-1823.8232**	**-1818.4238**	**908.8047**
	t	0.1310	0.0005	-1732.7807	-1727.3813	864.9755
	Clayton	0.5309	0.0005	-1201.8948	-1196.4954	326.8904
	Frank	0.0598	0.0005	-1758.4100	-1753.0106	879.3316
	Gumbel	0.1323	0.0005	-1747.1018	-1741.7024	870.3753

	Joe	0.9494	0.0005	-1456.9277	-1451.5283	726.1706
Model M23	Normal*	**0.0402**	0.0025	**-2219.2454**	**-2213.8460**	**1100.8888**
	t	0.1061	0.0005	-2142.4721	-2137.0727	1065.1773
	Clayton	0.4923	0.0005	-1531.4791	-1526.0797	458.0981
	Frank	0.0644	0.0005	-2160.5108	-2155.1114	1083.6490
	Gumbel	0.1264	0.0005	-2114.8745	-2109.4751	1057.1608
	Joe	1.0130	0.0005	-1742.2796	-1736.8802	859.4011
Model M31	Normal*	**0.0437**	0.0025	**-1836.4099**	**-1830.9679**	**916.3304**
	t	0.1230	0.0005	-1752.5438	-1747.1019	871.7316
	Clayton	0.5844	0.0005	-1239.5138	-1234.0719	353.8382
	Frank	0.0750	0.0005	-1793.9180	-1788.4761	895.0620
	Gumbel	0.1397	0.0005	-1732.8884	-1727.4465	860.4503
	Joe	1.0547	0.0005	-1419.0104	-1413.5685	707.7315
Model M32	Normal*	**0.0734**	0.0005	**-1980.6022**	**-1975.1603**	**985.0178**
	t	0.1606	0.0005	-1872.5831	-1867.1412	931.3925
	Clayton	0.7262	0.0005	-1254.5368	-1249.0949	282.3220
	Frank	0.1011	0.0005	-1914.4780	-1909.0361	956.8899
	Gumbel	0.0886	0.0005	-1916.6963	-1911.2544	951.8412
	Joe	0.7803	0.0005	-1625.6206	-1620.1787	807.3084
Model M33	Normal*	**0.0501**	0.0015	**-2342.8707**	**-2337.4288**	**1166.8050**
	t	0.1079	0.0005	-2256.5547	-2251.1128	1120.1798
	Clayton	0.6404	0.0005	-1602.5468	-1597.1049	488.8919
	Frank	0.1047	0.0005	-2227.4291	-2221.9872	1113.0263
	Gumbel	0.0723	0.0005	-2252.1064	-2246.6645	1122.4463
	Joe	0.7975	0.0005	-1885.9234	-1880.4815	938.5881

Table 6 (Continued) Selection of the best copula model

		Goodness of Fit Test		Information Criteria		
Model	Copula	CvM	p value	AIC	BIC	CIC
Model F11	Normal	0.0279	0.1064	-94.3829	-91.7678	45.8349
	t	0.0395	0.0305	-88.1103	-85.4952	42.8937
	Clayton	0.0673	0.0035	-68.5421	-65.9269	11.8895
	Frank*	**0.0233**	0.1234	**-96.1168**	**-93.5017**	**48.8754**
	Gumbel	0.0372	0.0485	-85.6661	-83.0510	43.2265
	Joe	0.1033	0.0015	-68.3828	-65.7677	26.4905
Model F12	Normal*	**0.0180**	0.3881	**-81.4144**	**-78.7993**	**39.4696**
	t	0.0339	0.0794	-73.4414	-70.8262	34.2042
	Clayton	0.0517	0.0155	-55.2510	-52.6358	10.5081
	Frank	0.0157	0.4890	-76.5508	-73.9357	37.5761
	Gumbel	0.0292	0.1134	-74.9429	-72.3278	36.6713
	Joe	0.0842	0.0025	-61.7298	-59.1147	29.9567
Model F13	Normal	0.0294	0.0514	-123.6421	-121.0270	60.3359
	t	0.0347	0.0255	-122.1683	-119.5532	58.7985
	Clayton	0.0486	0.0095	-98.0322	-95.4171	22.8606
	Frank*	**0.0150**	0.3541	**-127.3674**	**-124.7523**	**63.3642**
	Gumbel	0.0410	0.0215	-113.6253	-111.0102	57.0905
	Joe	0.1292	0.0005	-89.1367	-86.5216	41.3561
Model F21	Normal*	**0.0313**	0.0195	**-1684.5886**	**-1679.1502**	**843.0044**
	t	0.0860	0.0005	-1631.2507	-1625.8123	810.4349
	Clayton	0.6100	0.0005	-1129.4387	-1124.0003	352.4272
	Frank	0.0829	0.0005	-1589.7045	-1584.2661	794.8592
	Gumbel	0.0823	0.0005	-1648.4645	-1643.0261	822.9915
	Joe	0.7999	0.0005	-1388.1743	-1382.7359	689.1320
Model F22	Normal*	**0.0291**	0.0275	**-1865.3743**	**-1859.9360**	**932.8761**
	t	0.1029	0.0005	-1780.1917	-1774.7533	888.8107
	Clayton	0.5881	0.0005	-1243.1867	-1237.7484	366.7113
	Frank	0.0768	0.0005	-1764.1615	-1758.7231	882.3307
	Gumbel	0.0959	0.0005	-1793.7086	-1788.2702	892.1150
	Joe	0.8738	0.0005	-1500.1892	-1494.7508	746.4985

Model F23	Normal*	**0.0277**	0.0315	**-2169.4330**	**-2163.9946**	**1085.8801**
	t	0.0889	0.0005	-2094.2331	-2088.7947	1043.9665
	Clayton	0.5286	0.0005	-1536.9721	-1531.5338	516.9028
	Frank	0.0765	0.0005	-2045.9703	-2040.5319	1021.3401
	Gumbel	0.1144	0.0005	-2055.0322	-2049.5938	1023.0629
	Joe	0.9980	0.0005	-1689.3811	-1683.9427	838.3634
Model F31	Normal*	**0.0316**	0.0165	**-1766.7548**	**-1761.3802**	**884.1718**
	t	0.1052	0.0005	-1694.9972	-1689.6226	844.0886
	Clayton	0.4469	0.0005	-1298.0983	-1292.7237	471.7959
	Frank	0.0496	0.0005	-1684.2674	-1678.8928	841.1828
	Gumbel	0.1844	0.0005	-1618.2542	-1612.8796	805.9786
	Joe	1.2101	0.0005	-1284.6458	-1279.2712	638.3470
Model F32	Normal*	**0.0581**	0.0005	**-1908.8210**	**-1903.4463**	**948.0684**
	t	0.1266	0.0005	-1830.2134	-1824.8387	908.2109
	Clayton	0.6349	0.0005	-1273.3662	-1267.9915	367.3689
	Frank	0.0817	0.0005	-1835.8852	-1830.5106	916.6340
	Gumbel	0.0862	0.0005	-1838.5946	-1833.2200	912.5179
	Joe	0.7790	0.0005	-1543.1495	-1537.7748	765.9583
Model F33	Normal*	**0.0207**	0.0834	**-2285.3918**	**-2280.0172**	**1138.6953**
	t	0.0680	0.0005	-2208.7831	-2203.4085	1097.5980
	Clayton	0.4367	0.0005	-1700.1341	-1694.7595	630.9208
	Frank	0.0810	0.0005	-2142.4474	-2137.0727	1070.7635
	Gumbel	0.1233	0.0005	-2117.8157	-2112.4410	1053.3135
	Joe	1.0604	0.0005	-1705.0189	-1699.6442	846.1195

The parameter estimates (MPLE) and standard error values for the copulas selected for each model are presented in Table 7.

Table 7
Parameter estimation results for selected copula models

Gender	Education Level	Couple	Model	Copula	Estimate	Standard Error
Male	Low	Math-Reading	Model E11	Frank	9.1478	0.9950
		Math-Science	Model E12	Normal	0.8389	0.0211
		Reading-Science	Model E13	Frank	8.9777	1.0773
	Middle	Math-Reading	Model E21	Normal	0.8062	0.0077
		Math-Science	Model E22	Normal	0.8214	0.0071
		Reading-Science	Model E23	Normal	0.8630	0.0055
	High	Math-Reading	Model E31	Normal	0.8134	0.0066
		Math-Science	Model E32	Normal	0.8301	0.0067
		Reading-Science	Model E33	Normal	0.8653	0.0054
Female	Low	Math-Reading	Model K11	Frank	7.8731	1.1864
		Math-Science	Model K12	Normal	0.7657	0.0456
		Reading-Science	Model K13	Frank	10.4114	1.1583
	Middle	Math-Reading	Model K21	Normal	0.7946	0.0081
		Math-Science	Model K22	Normal	0.8177	0.0073
		Reading-Science	Model K23	Normal	0.8503	0.0064
	High	Math-Reading	Model K31	Normal	0.8199	0.0072
		Math-Science	Model K32	Normal	0.8368	0.0069
		Reading-Science	Model K33	Normal	0.8739	0.0054

Joint and conditional probabilities for PISA achievement scores

In this section, joint and conditional probabilities are calculated for the 2018 PISA Mathematics, Reading and Science achievement scores of male and female students classified according to their education levels at home, using the most appropriate marginal distributions and copula models determined in the previous sections. Here, for each model defined in Table 1, the

averages of the scores were taken as threshold values and the probabilities of success above these threshold values were evaluated. The results obtained are presented in Table 8.

The best-fit marginal distribution parameters for male and female students' Mathematics, Reading and Science scores are given in Tables 4 and 5, respectively, and the copula goodness of fit results are given in Table 6. The mean values presented in Table 2 were used as threshold values. In addition, the probability of students who achieved above average success in a particular course to achieve the same success in other courses was analyzed using conditional probability methods using equations (3) and (4).

In order to examine the effect of reading on mathematics and science achievement, some joint and conditional probabilities were analyzed together. Table 8 presents the joint and conditional probabilities calculated based on the selected copula models for mathematics-reading, mathematics-science and reading-science pairs. In the calculation of these probabilities, U (0,1) transformations based on marginal information were applied and the results were expressed with the notations $\bar{C}_v(u)$ and $\bar{C}_u(v)$ defined in equations (6), (7) and (8), respectively.

The results obtained show how the probabilities of students' succeeding in certain courses can change with conditional probabilities. For example, in model M31, the probability of being successful in both math and reading is 38.67%. In comparison, the probability that a student who is successful in reading is also successful in math is calculated as 77.34% using the conditional probability information $\bar{C}_v(u)$. The F31 model's probabilities are 38.74% and 77.47%, respectively.

Table 8
Joint and conditional probabilities for selected copula models.

Models	Selected copulas	Estimate	Threshold values		$\bar{C}(u,v)$	$\bar{C}_v(u)$	$\bar{C}_u(v)$
Model M11	Frank	9.1478	$\bar{x}_m = 365.3851$	$\bar{x}_r = 373.6318$	0.4153	**0.8817**	0.8097
Model M12	Normal	0.8389	$\bar{x}_m = 365.3851$	$\bar{x}_s = 399.9808$	0.3959	0.8499	0.7720
Model M13	Frank	8.9777	$\bar{x}_r = 373.6318$	$\bar{x}_s = 399.9808$	0.3925	0.8425	**0.8333**
Model M21	Normal	0.8062	$\bar{x}_m = 446.9170$	$\bar{x}_r = 441.5230$	0.3986	**0.7982**	0.7982
Model M22	Normal	0.8214	$\bar{x}_m = 446.9170$	$\bar{x}_s = 451.1460$	0.4092	0.7984	0.8195
Model M23	Normal	0.8630	$\bar{x}_r = 441.5230$	$\bar{x}_s = 451.1460$	0.4215	0.8223	**0.8442**
Model M31	Normal	0.8134	$\bar{x}_m = 470.5440$	$\bar{x}_r = 466.5770$	**0.3867**	**0.7734**	0.8191
Model M32	Normal	0.8301	$\bar{x}_m = 470.5440$	$\bar{x}_s = 476.8362$	0.3913	0.7826	0.8289
Model M33	Normal	0.8653	$\bar{x}_r = 466.5770$	$\bar{x}_s = 476.8362$	**0.4164**	0.8329	**0.8329**
Model F11	Frank	7.8731	$\bar{x}_m = 358.3634$	$\bar{x}_r = 399.1779$	0.4030	**0.8678**	0.7771
Model F12	Normal	0.7657	$\bar{x}_m = 358.3634$	$\bar{x}_s = 412.4590$	0.3772	0.8157	0.7272
Model F13	Frank	10.4114	$\bar{x}_r = 399.1779$	$\bar{x}_s = 412.4590$	0.3974	0.8594	**0.8556**
Model F21	Normal	0.7946	$\bar{x}_m = 441.6859$	$\bar{x}_r = 467.9501$	0.3776	**0.7551**	0.8129
Model F22	Normal	0.8177	$\bar{x}_m = 441.6859$	$\bar{x}_s = 461.2697$	0.3837	0.7674	0.8261
Model F23	Normal	0.8503	$\bar{x}_r = 467.9501$	$\bar{x}_s = 461.2697$	0.4118	0.8236	**0.8236**
Model F31	Normal	0.8199	$\bar{x}_m = 465.7769$	$\bar{x}_r = 493.5980$	**0.3874**	**0.7747**	0.8241
Model F32	Normal	0.8368	$\bar{x}_m = 465.7769$	$\bar{x}_s = 489.7940$	0.3921	0.7842	0.8342
Model F33	Normal	0.8739	$\bar{x}_r = 493.5980$	$\bar{x}_s = 489.7940$	**0.4192**	0.8384	**0.8384**

Similarly, in model M33, the probability of being successful in both reading and science is 41.64%, whereas the probability of a student who is successful in reading is also successful in science, 83.29% was obtained with conditional probability information $\bar{C}_u(v)$. A similar situation was observed in the F33 model, where the probabilities were calculated as 41.92% and 83.84%, respectively.

According to these results, female students with higher levels of education at home have higher joint and conditional probabilities of success than male students Especially when the reading achievement of girls with higher levels of education is considered, they are more likely than boys to be successful in both math and science. However, this situation shows a reverse trend at other education levels.

In general, the results show that students' success in one subject can positively affect their probability of success in other subjects. In other words, a student who is known to be successful in one subject is more likely to be successful in other subjects, while the probability of being successful in both subjects is lower. While these probabilities are expected to increase as the level of education at home increased, in some cases it has been observed that a student who is known to be successful in reading is less likely to be successful in math or science. These findings suggest that home education may have a significant effect on student achievement, but that this effect is not constant and consistent in all cases.

The study allows for an examination of the dependency structures between achievement scores stratified by educational levels at home and a more detailed assessment of the probabilities of students achieving above average. It also reveals how these probabilities change according to different levels of education. In this context, dependency models and copula functions allow not only to calculate the probabilities of above-average achievement, but also to analyze how these probabilities change conditionally.

Conclusion

This study examined how the dependency structures between students' achievement in mathematics, reading, and science vary with demographic factors such as gender and level of education at home, using 2018 PISA data. Analyses with copula functions identified the most appropriate models to accurately predict achievement probabilities.

In particular, the dependency between PISA achievement scores of male and female students according to their level of education at home was examined using copula functions. First, various models were created for PISA achievement scores according to these demographic characteristics and the best copulas were determined for each model created with the CvM goodness of fit test, and the selected functions were supported by AIC, BIC, and CIC criteria. Then, some joint probabilities were obtained using the parameter estimates made with the pseudo-maximum likelihood (MPLE) method. Here, the averages for each model were taken as thresholds and the probabilities of the achievement scores exceeding these thresholds were considered as success. In addition, conditional probabilities were calculated to see the effect of reading on math and science courses.

The results show that the level of education at home has a partial effect on students' likelihood of success, but this effect is not consistent in all cases. Female students with higher levels of education were found to be more likely than male students to be successful in mathematics based on their success in reading.

As a result, the findings of the study show that copula models are an effective tool in understanding the dependent factors affecting student achievement and can be used effectively in educational analyses. These analyses constitute an important basis for examining the effects of other demographic variables, other than home education, on achievement and for better guiding students' educational processes.

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Research Article
Received: 07.11.2024
Accepted: 31.12.2024
Published: 31.12.2024

Citation: Acemioğlu, R., & Doğan, Y. (2024). Examining curriculums in terms of healthy nutrition outcomes in the context of class level. *International Journal of Scholars in Education*, *7*(2), 185-196. https://doi.org/10.52134/ueader.1603026

Examining Curriculums in Terms of Healthy Nutrition Outcomes in the Context of Class Level*

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Abstract: This study aimed to examine the healthy nutrition outcomes gained by curriculums introduced and implemented in 2018, focusing on grades and lesson durations. The study employed a qualitative research strategy and used the document review technique.. The data, collected from the analysis of six different curricula, were evaluated using content analysis. Through analysis, 38 healthy nutrition outcomes were identified and categorized under themes after coding. The lesson duration and grade level evaluation findings indicate that healthy nutrition outcomes were not evenly distributed across class levels.The Science Curriculum (SC) does not include any healthy nutrition learning outcomes for the 5th grade, and the Physical Education and Games Curriculum (PEGC) excludes them for the 2nd grade. Similarly, the Secondary School Biology Curriculum (SSBC) includes such learning outcomes only in the 9th grade. Regarding lesson durations, the average time allocated to healthy nutrition outcomes was determined as 2.5–3 hours in the Life Sciences Curriculum (LSC), 1.5–3 hours in the SC, 1.5–2.5 hours in the Secondary School Physical Education and Sports Curriculum (SEPESC), and 8.5 hours in the SSBC. However, lesson durations were not specified for the learning outcomes in PEGC and SEPESC. These results emphasize the need to distribute outcomes more equitably and systematically across class levels in alignment with pedagogical principles. Furthermore, organizing healthy nutrition outcomes with spiral structure is recommended to ensure learning continuity and prevent incomplete understanding. This study highlights the importance of adopting a planned and systematic approach in curriculum design to enhance the effective integration and balanced distribution of healthy nutrition outcomes.
***Keywords**:* Healthy nutrition, Achievement, Curricula.

* This research was presented as a summary at the VII. International TURKCESS Education and Social Sciences Congress in 2021.
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Introduction

The living conditions provided to individuals impact their ability to grow and develop in a healthily from childhood, as well as genetic characteristics (Konca et al., 2019). Healthy living conditions are proportional to healthy nutrition. Healthy living conditions are proportional to healthy nutrition. Healthy nutrition forms the basis of a healthy life process. For this reason, living a healthy life is related to healthy nutrition. Healthy nutrition contributes to the mental and physiological state of individuals (Tayhan Kartal et al., 2019). According to İrcal-Sümbül (2009), the nutritional factor is also very important in maintaining a healthy life in addition to physical activity and sleep patterns. Teaching individuals how to maintain a healthy nutrition process and the effects of this process on healthy life can be considered as the basic step for a healthy life cycle. The importance of an effective education and training process in teaching the requirements of healthy nutrition for maintaining a healthy life cannot be ignored. As a matter of fact, an effective education and training process means a good nutritional habit transferred to future generations (Pekşen Akça et al., 2013). An effective education process can play an active role in teaching a subject and reaching target behaviours. The harmony between the process of reaching the targeted behaviours and the objectives can be considered as a precondition for a quality teaching. At all levels of education, an education process that is compatible with the objectives of the curriculum is ensured by education programmes (Erbagcı & Kaf, 2020). The organisation of education and training activities as a whole is defined as a curriculum (Pratt 1980). Educational programmes, which include learning objectives, content arrangements, teaching methods, evaluation processes and learning experiences, consist of behaviour, learning outcome or outcome-based objectives (Burul, 2018). Outcome, which is among these objectives, is a concept that has been emphasised in recent years (Yakar, 2016).

Education programs, which aim to provide students with the attitudes and skills needed to acquire knowledge and solve the problems they will encounter, structure the phenomenon of attainment as concrete and measurable goals to be achieved in the education process (Kaptan, 1999). Therefore, in the planning of the educational process, it is critical that educational programs set goals that aim to provide attitudes and skills for students' needs and that these goals are transformed into concrete achievements through curriculum. In the planning of the educational process, the curriculum, as well as educational programs, provide concrete contents that enable students to reach the determined goals (Laska & Gürbüztürk, 2019). While education programs, which are prepared in a wider framework than curriculum, determine the policies and objectives of education, the curriculum focuses on the in-class and out-of-class practices of a course (Özdemir, 2009). On the other hand, curriculum makes education programs applicable (Küçükahmet, 2003) by detailing the learning objectives, content, teaching methods and assessment tools for a specific course (Dönmez & Zorluoğlu, 2020). Demirel (2013) defined the curriculum as all activities related to the teaching of the course aimed to be gained by individuals inside and outside the school according to a plan. The objectives constitute an important dimension of the curriculum. The achievable goals and behaviours in the curricula should be consistent within themselves (Sıcak & Arsal, 2014). The consistency between objectives and behaviours has an important place in terms of providing effective and efficient teaching. This consistency is directly related to the knowledge and skills that individuals gain through formal and informal activities in the learning process (Elmas et al., 2021). The permanent effect and instructive dimension of the activities performed during the education process reveal how important learning outcomes are in achieving the desired outcomes (Black & William, 2009). In this context, the objectives of the curriculum not only transfer knowledge, but also stand out as an important factor that supports the application of the relevant subjects to life (Akın, 2007). While preparing the objectives, the content of the course should be carefully considered and the excess of concepts and objectives that will make it difficult for students to make sense of the information should be avoided (Cangüven et al., 2017; Demir, 2020). Therefore, it can be said that a curriculum prepared by avoiding the excess of concepts and

acquisitions is effective in realising an efficient learning process. The curriculum structured by avoiding the redundancy of concepts and outcomes aims to improve individuals' ability to access information and to equip them with the necessary skills to lead a healthy and safe life, just like the Life Sciences Curriculum (LSC) (MoNE, 2018a). LCS aims to raise individuals who recognise themselves and the environment in which they live, use information and communication technologies appropriately, and have the awareness of living a healthy and safe life to ensure an effective and efficient education and training process (MoNE, 2018a).

The main objective of the SC is to raise science literate individuals who can research, think critically, question, and find solutions to the problems they will face (MoNE, 2018b).SEPESCC is aimed to raise individuals who gain health-enhancing skills and attitudes by staying away from habits that affect physical and mental health (MoNE, 2018c). The aim of the PEGCC and the PESCC (Secondary School Grades 5, 6, 7 and 8) is to prepare students for the next levels of education by providing them with the concepts and skills that will develop healthy life skills along with the basic movements they will use throughout their lives (MEB, 2018d; MEB, 2018e). Furthermore, SEBCC aims to know the basic theories, principles and experiments related to biology; to raise individuals who can use biology knowledge and practices in daily life, discuss and evaluate socioscientific issues, research, think, question, and produce (MoNE, 2018f). Each of the related learning outcomes corresponds to the objectives in the curriculum. These outcomes in the curriculum not only enable students to think and question critically, but also include elements that provide them with the skills to have a healthy life process. The learning outcomes serve as a guide on what and how to teach students in the learning process. For this reason, the adequacy of the objectives in the curriculum according to the grade levels plays an important role in regulating the learning-teaching process to respond to the needs by providing an efficient and permanent education process according to the determined objectives. In this context, structuring the outcomes in the curricula according to the grade levels ensures the effective teaching of subjects such as nutrition, which is of lifelong importance, and the permanence of education on these subjects (Çolak, 2019). Thus, the adequacy of the achievements related to nutrition in the curriculum is important in terms of having correct nutritional knowledge and gaining positive eating habits. In this context, this study aimed to determine the distribution of the learning outcomes related to healthy nutrition in the curricula of HLBLC, FBLC, BEODLC, OBESLC and BLC, which were published and entered into force in 2018, according to the grade level. Based on the aim of the research, the main problem statement was “How do the learning outcomes related to healthy nutrition in different curriculums of primary and secondary education show a distribution according to the grade level”. Answers to the following sub-problems were sought within the framework of this main problem.

1. How do the learning outcomes related to healthy nutrition in different curriculums vary according to grade level?
2. How do the average lesson hours of the acquisitions related to healthy nutrition in different curriculums vary according to the grade level?

Method

Research Design

This study was designed qualitative research model and it was conducted with the document analysis technique. Qualitative research is a paradigm in which mutual interaction and relationship are emphasised and data are collected through interviews, observations and written materials (Balcı, 2018). Document analysis is a technique that includes the process of collecting data from written records and documents by saving time and resources for the

researcher (Karasar, 2016; Şimşek, 2009). Since examining the gains related to healthy nutrition in different curricula with the document review technique enables this study to be handled from a multidimensional and comprehensive perspective; in this study, the gains related to healthy nutrition in the curricula published and included in the curricula that came into force in 2018 were examined in terms of grade level and average course hour duration.

Data source

In this study, six different curricula published and implemented in 2018 were examined as data sources. The reason for examining the curricula of different courses as a data source was to ensure that nutrition outcomes were analysed not only through a single curriculum, but also through various curricula to provide a more holistic perspective on the subject.

Data Analysis

The content analysis method was used to analyse the data according to the stages of the document analysis approach. Reaching the relationships that can explain the data obtained was a basic aim of content analysis (Yıldırım & Şimşek, 2013). Content analysis is the process of analysing published materials thematically in specified categories (Duran & Kenanoğlu, 2020). In the curriculum examined through content analysis, 38 learning outcomes related to nutrition were identified, and each learning outcome was coded by creating themes for the learning outcomes. The opinions of two experts in the field were taken to ensure consensus among the coders regarding the coded acquisitions and the themes created. According to the expert opinions, the percentage of agreement/disagreement regarding the coding of the acquisitions was determined as 90% and the percentage of agreement regarding the themes created for the acquisitions was determined as 85%. In order for a research to be reliable, it was sufficient for the percentage of agreement to be at least 70% (Miles & Huberman, 1994).

In this research, the coded learning outcomes and the themes related to the learning outcomes were categorised and presented in a Table 1 as unit/learning areas, theme, grade level, frequency, and average lesson hour duration as part of the content of the curriculum. While determining the average course hours for the learning outcomes, the total course hours given in the subject area related to the learning outcome were divided by the total number of learning outcomes. Thus, the average lesson time for each outcome was calculated.

Findigns

In this part of the study, the results of the analysis of 38 learning outcomes related to healthy nutrition in the curricula of different courses published in 2018 were presented.

Table 1
The Distribution of Healthy Eating Outcomes in LSC According to Grade Level and Lesson Hour Duration

Curriculum /Unit	Theme	Grade	Learning outcomes	f	Average lesson hours
"Life Science/Healthy Life"	Basic Principles of Healthy Living	1	Awareness of health protection	4	3
			Selection of foods and drinks that are beneficial for health		3
			Balanced and regular nutrition		3
			Preparing food by paying		3

			attention to hygiene rules		
	Healthy Life Cycle: Nutrition and Hygiene	2	Factors affecting healthy development	4	3
			Preparing a balanced nutrition list		3
			Cleaning for a healthy life		3
			Consuming seasonal food		3
	Conscious Consumption and Nutrition	3	Conscious consumption behaviour	3	2.5
			Nutrition according to the seasons		2.5
			Healthy eating		2.5
Total				**11**	**31.5**

According to Table 1, a total of 11 learning outcomes related to healthy nutrition were determined in the Healthy Life unit of the Life Science Curriculum. Four of these learning outcomes were within the scope of 'basic principles of healthy life' and 'healthy life cycle: nutrition and hygiene' themes. The results in Table 1 showed that there were three learning outcomes under the theme of 'conscious consumption and nutrition' for the 3rd grade, which aimed to provide students with skills such as exhibiting conscious consumer behaviours when purchasing food and beverages, eating foods suitable for the seasons, and eating adequate and balanced nutrition to protect their health. When the results in Table 1 were analysed in terms of average lesson hour duration, it was seen that the average lesson hour duration for each learning outcome was three hours for the 1st and 2nd grades. At the 3rd grade level, the average lesson time for the healthy eating outcome was 2.5 hours.

Table 2
Class Level and Lesson Hour Distribution of Healthy Eating Outcomes in SC

Curriculum /Unit	Theme	Grade	Learning Outcomes	f	Average lesson hours
'Science Curriculum' / 'Earthlings and Life'	Sensory organs and healthy nutrition	3	Maintaining the health of the sense organs	1	2
	Nutrition, health and responsibility awareness	4	Relationship between sustainable vitality and nutrient content	6	3
			Water and mineral analysis in foods		3
			Awareness of consuming natural and fresh food		3
			Relationship between health and balanced nutrition		3
			Harmful habits and health awareness		3
			Taking responsibility for harmful habits		3
	-	5	-	-	-
	Body health during adolescence	6	Adolescence healthy life strategies	2	2
			Nutrition for system health		2
	Healthy development	7	Healthy living strategies in embryonal development	1	2
	Biotechnology and human health	8	Effects of biotechnology on humanity	1	1.5
Total				**11**	**27.5**

When Table 2 was analysed, one outcome related to the theme of 'sense organs and healthy nutrition' was observed at the 3rd grade level of the science curriculum. Moreover, one outcome each for the 7th and 8th grades was related to the themes of 'healthy development' and 'biotechnology and human health'. According to Table 2, 6 objectives related to nutrition at the

4th grade level were associated with the theme of 'nutrition, health and responsibility awareness'. At the 6th grade level, 2 objectives related to nutrition were matched with the theme of 'body health in adolescence', while there were no objectives related to healthy nutrition for the 5th grade. When Table 2 was analysed in terms of average lesson hours, the average lesson hours of each outcome related to healthy nutrition in grades 3, 6 and 7 were two hours each. Furthermore, it can be seen that the average lesson hour duration of each outcome related to nutrition was three hours in the 4th grade and one and a half hours in the 8th grade.

Table 3
The Distribution of Healthy Eating Outcomes in The SSPESC by Grade Level and Duration of Class Hours

Curriculum /Unit	Theme	Grade	Learning Outcomes	f	Average lesson hours
"Physical Education and Sports"/"Active and Healthy Life"	Nutrition and Movement: The Key to a Balanced Life	9	Relationship between healthy eating and physical activity	1	1.5
	Active Living and Nutrition Awareness	10	Physical activity for a healthy life Obtaining nutrition information from the right sources	2	1.5 1.5
	Knowing the Principles of Healthy Eating Preventing Harmful Habits	11	To explain the principles of healthy nutrition To explain the nutritional habits that affect physical and mental health	2	1.5 1.5
	Negative Aspects of Active Living and Addictions	12	Health hazards of a sedentary life The negative effects of harmful habits on athletes	2	2.5 2
Total				**7**	**12**

According to Table 3, there was only one outcome under the theme of "nutrition and movement: the key to a balanced life". "Under the theme of 'active life and nutrition awareness', there were two learning outcomes at the 10th grade level that mentioned the necessity of regular physical activity for a healthy life and emphasized the importance of obtaining information from the right sources for a healthy diet. Moreover, the results in Table 3 showed that there were two learning outcomes at the 11th and 12th grade level, each focusing on explaining the basic principles of healthy nutrition and drawing attention to learning the factors that can negatively affect physical and mental health. These learning outcomes were associated with the themes of "preventing harmful habits by knowing the principles of healthy nutrition" and "negative aspects of active life and addictions" respectively. Table 3 shows that the average lesson hour time for each result linked to good nutrition was one hour for the ninth, tenth, and eleventh graders. At the 12th grade level, this situation was observed to be 2.5 hours for the outcome coded "the harm of sedentary life to health" and two hours for the outcome coded "the negative effects of harmful habits on athletes".

Table 4
Distribution of Healthy Eating Outcomes in SSPEGC by Grade Level and Duration of Class Hours

Curriculum/Unit	Theme	Grade	Learning Outcomes	f	Average lesson hours
"Physical Education and Play"/"Active and Healthy Life"	Nutrition in Active Living	1	To gain healthy eating habits for participation in games and physical activities	1	-
	-	2	-	-	-
	Nutrition in Active Living	3	Nutrition before and after the activity	1	-

	Planned Nutrition	4	Individual nutrition program preparation	1	-
Total				**3**	**-**

When Table 4 was examined, it was seen that one outcome in the curriculum at the 1st and 3rd grade level was related to the importance of proper nutrition while participating in games and physical activities within the scope of the theme of "nutrition in active life". Besides, one outcome for the 4th grade was associated with the theme of "planned nutrition" and no nutrition outcome for the 2nd grade was identified in the SSPEGC. Table 4 shows that the average lesson hour duration was not calculated since the lesson hour durations of the learning outcomes related to healthy nutrition were not given on a subject basis in SSPEGC.

Table 5
Distribution of Healthy Nutrition Outcomes by Grade Level and Lesson Hour Duration in PEGC

Curriculum /Unit	**Theme**	**Grade**	**Learning Outcomes**	**f**	**Average lesson hours**
"Physical Education and Sports" / "Active and Healthy Life"	*Physical Activity and Nutrition: Energy Management and Informed Choices*	5	Relationship between physical activity and nutritional requirements	1	-
		6	Knowledge of nutrients that provide energy for physical activities	1	-
		7	Preparing individual nutrition program for physical activities	1	-
		8	Demonstrate conscious nutrition behaviors for physical activity	1	-
Total				**4**	**-**

According to the results in Table 5, a total of four learning outcomes related to healthy eating were identified at the 5th, 6th, 7th and 8th grade levels. These outcomes were related to the theme of "physical activity and nutrition: energy management and conscious choices", one at each grade level. Moreover, when Table 5 wes examined, it was seen that the average lesson hour duration of the acquisitions related to healthy nutrition in PEGC was not calculated since the lesson hour duration is not given in the curriculum on the basis of subject.

Table 6
Class Level and Lesson Hour Duration Distribution of Healthy Nutrition Outcomes in SSBC

Curriculum /Unit	**Theme**	**Grade**	**Learning Outcomes**	**f**	**Average lesson hours**
"Biology"/ "Basic Components in the Structure of Living Things"	Basic Components of Living Things and Healthy Nutrition	9	Knowledge of organic and inorganic compounds	2	8.5
			Food components and healthy eating		8.5
	-	10	-	-	-
	-	11	-	-	-
	-	12	-	-	-
Total				**2**	**17**

When Table 6 was examined, it was seen that only two learning outcomes in the 9th grade level of the biology curriculum were related to healthy nutrition, while there were no learning outcomes related to nutrition in the other grade levels. Table 6 showed that two learning outcomes in the biology curriculum were related to the theme of "basic components of living things and healthy nutrition". Furthermore, the learning outcomes related to healthy nutrition in the SSBC reflect an average of 17 hours of lesson time.

Conclusion, Discussion and Recommendations

The results of this study revealed differences in the distribution of healthy nutrition outcomes in different curricula that came into effect as of 2018. One of these differences was that the healthy nutrition outcomes in the curricula were not distributed equally according to the grade level. For example, while there were no outcomes related to healthy nutrition in the fifth grade of the science course curriculum, and in the second grade of the primary school physical education and games course, there were only relevant outcomes in the ninth-grade level for the biology course. This may be because the cognitive capacities and learning needs of students were considered when preparing curricula (Özçelik, 2014). There may not be any learning outcomes related to healthy nutrition for every grade level. However, curriculums should be structured gradually, equipped with learning outcomes appropriate to students' development and grade levels, and designed in a planned and systematic manner in line with pedagogical principles to facilitate the achievement of learning objectives (Avcı, 2014). Ursavaş et al. (2020) emphasized the importance to structure curriculum learning outcomes to enhance cognitive growth of students. The fact that the outcome related to a multidisciplinary subject such as healthy nutrition was not available at every grade level may be due to the uncertainty about which discipline the subject can be handled in (MEB, 2018g). At the same time, the outcomes related to healthy nutrition were not included in some grade levels may be due to the difference in pedagogical approaches (Niess, 2006). Studies conducted in the literature on the examination of the outcomes included in the curriculum (Deveci, 2018; Doğan and Burak, 2018; Ertan, 2013; Gültekin and Burak, 2019; Özata Yücel and Özkan, 2013; Akar and Keyvanoğlu 2016; Zorluoğlu et al., 2020; Efe and efe, 2018; Kuzu et al., 2019; Taşcı, 2023) confirmed this difference. According to the results, some grade levels did not include achievements related to healthy nutrition may be due to the spiral structure (Sünbül, 2011) not being taken into consideration sufficiently in the preparation of the curriculum. The spiral structure was a system that aimed to ensure continuity in learning by repeating and expanding achievements following grade levels and ensuring that the subjects continued in continuation of each other (Kılıç, 2019). In this context, the results obtained from this research, it was thought that revising the achievements in the curriculum following the spiral structure to cover all grade levels (Kılıç, 2019) can be beneficial in preventing incomplete or incorrect learning in learning concepts related to healthy nutrition.

The results revealed that the lesson hours vary from curriculum to curriculum and from grade level to grade level. For example, while the mean lesson hour duration for healthy nutrition outcomes in LSC varies between 2.5 and three hours, this duration was 8.5 hours in SSBC. At the same time, the mean lesson hour duration for healthy nutrition outcomes varied between 1.5-3 hours in SC and 1.5-2.5 hours in SSPESC. However, in some curricula (PEGC and SSPESC), lesson hour durations were not specified on an outcome basis. This situation indicated that the curriculum has a deficiency in terms of providing consistency and guidance in practice (Ursavaş, Aytar, & Alpay, 2020). In other studies examining the outcomes in different curricula in the context of course hours (Deveci, 2018; Demircioğlu et al., 2015; Akar and Keyvanoğlu 2016; Yayla and Yayla, 2017; Özcan and Kaptan, 2018; Ursavaş et al., 2020; Taşcı, 2023), it was emphasized that the course hours for the outcomes were insufficient. As a result, it was recommended that the achievements for healthy nutrition should be organized in a way that facilitates the attainment of learning objectives. In addition, a more planned and systematic approach should be adopted in line with pedagogical principles in the preparation of teaching programs. This can not only increase students' knowledge about healthy nutrition but can also support their ability to apply this information throughout life (Çolak, 2019). The recommendations developed based on the findings of the research are presented below:

- Healthy nutrition outcomes included in curricula should be organized in a balanced manner to prevent interruptions in the learning process and to reinforce knowledge systematically.

- Since the absence of specified course durations in some curricula may lead to inconsistencies in the implementation of outcomes, the lesson durations allocated for healthy nutrition outcomes should be defined and standardized across the curriculum.
- Researchers focusing on this subject could conduct studies evaluating the alignment of current outcomes with the Türkiye Yüzyılı Maarif Education Model (2024) and propose updates accordingly.

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Review Article
Received: 02.12.2024
Accepted: 31.12.2024
Published: 31.12.2024

Citation: Marangoz, M., & Kale, G. (2024). Digital diseases and digital detox. *International Journal of Scholars in Education*, *7*(2), 197-205. https://doi.org/10.52134/ueader.1372897

Digital Diseases and Digital Detox*

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Abstract: Depending on the developments in computer and internet technology, the concept of communication has become important for individuals and societies. People living in different geographical locations around the world have the opportunity to communicate with each other through computer networks. It has become possible to access information more easily and faster. In parallel with the developments in technology, new types of diseases have emerged and these diseases are defined as digital diseases. The inability to control the time spent in digital environments and the negative situations caused by excessive and unconscious use of technology cause some psychological problems. Digital addiction, nomophobia, netlessphobia, fomo, plagomania, digital obesity, online narcissism, selfitis, photolurking and cyberchondria are referred to as digital diseases. At this point, digital detox can be considered as a solution to avoid the negative effects of the internet. Digital detox is defined as a process in which an individual voluntarily chooses to stay away from digital devices. This process includes reducing social media use, going offline for certain hours or staying away from digital devices completely. Within the scope of this study, information on digital diseases and digital detox that occur due to uncontrolled technology use is included. Trainings on conscious internet and technology use can help individuals gain awareness against digital diseases and develop the right habits in digital environments.
***Keywords**:* Digital Diseases, Digital Detox, Technology Addiction, Conscious Internet Use.

*The abstract of this study was presented as an oral presentation at the 1st International Congress of Scientific Research and Innovation of Shirvanshahs held in Azerbaijan on November 23-24, 2024.

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Introduction

The rapid advancement of technology in the last century has transformed every aspect of life and radically altered individuals' lifestyles. These transformations have gained momentum especially with the widespread use of the internet and mobile technologies, bringing innovations in many areas from social interaction to entertainment, from working life to education. As access to the internet and digital devices has become easier and digitalization has accelerated, individuals have started to use these devices more intensively. However, while these innovations have facilitated human life, they have also paved the way for a series of new problems arising from excessive and uncontrolled use of digital devices and the internet. These new problems, which negatively affect human health, are called digital diseases. These diseases, whose symptoms usually emerge when deprived of the use of digital tools, affect individuals physically and mentally and cause them to experience behavioral disorders.

Digital illnesses include a range of psychological and behavioral disorders that develop due to the overuse of technology and negatively affect individuals' daily life activities. The prevalence of these disorders is increasing due to the impact of digital devices and applications that have become an integral part of modern lifestyles. Thanks to the possibilities offered by technology, individuals can make social connections, have fun and access various information quickly in the online world. However, these opportunities may lead to the development of an uncontrolled attachment in individuals and increase anxiety and restlessness in offline times. In particular, problems in accessing new media tools can lead to many psychological problems.

A culture of conscious technology use should be created to minimize the negative effects of technology while maintaining its positive effects on individuals. The implementation of digital literacy programs in educational institutions can help individuals cope with such problems. In addition, awareness-raising campaigns against the prevalence of digital diseases can contribute to a balanced relationship between individuals and technology.

In this study, digital diseases that arise due to uncontrolled technology use and digital detox practices that have significant potential to prevent these diseases are included. Due to the limited number of studies on digital illnesses in Turkey, it is thought that this study will make important contributions to the literature. Digital diseases such as digital addiction, nomophobia, netlessphobia, fomo, plagomania, digital obesity, online narcissism, selfitis, photolurking and cyberchondria are included in this study.

Digital Diseases

Digital Addiction

Digital addiction is a concept that describes the situation where individuals become overly dependent on digital devices, internet, social media, video games and other digital platforms. This type of addiction, just like substance addiction, is considered a form of behavior that negatively affects the daily life of the individual (Coşkuntürk, Kurcan, Yel & Güzel, 2023). Digital addiction occurs when individuals use digital devices and the internet in an uncontrolled and continuous manner. This addiction negatively affects individuals' time management, causes disconnections in their social relationships and disrupts the tasks they need to do in their real lives.

The main symptoms of digital addiction include the individual's constant desire to access digital devices, feeling discomfort and restlessness when not using the devices, unknowingly increasing the time spent on digital platforms, and neglecting daily responsibilities (Yengin &

Bayındır, 2019, 103). Digital addiction can cause individuals to disconnect from their social relationships, academic or work life and personal responsibilities (Topçu, 2019, 176). For example, spending most of the day playing online games while disrupting work or classes is a common example of digital addiction. Especially in young age groups, digital addiction negatively affects the development of social skills and leads to a weakening in face-to-face communication skills.

Individuals with digital addiction spend a large part of the day with digital devices and become restless when the time they spend in the digital environment decreases. These individuals may not realize that excessive use of digital devices is damaging their health and relationships. As a result, the digital environment is replacing social bonds in the real world.

Nomophobia

Nomophobia, which is the fear of being away from a smartphone, refers to the fear and anxiety experienced by individuals when they are away from their cell phones (Yıldırım & Correia, 2015). Individuals who experience nomophobia tend to keep their cell phones with them at all times, put their phones within their immediate reach even while sleeping, feel nervous when their cell phones are low, constantly check their phones, and spend too much time with their phones. The need for phones to be constantly accessible leads to social isolation and dependency in individuals. For example, an individual who panics when his/her phone battery runs out is a typical example of nomophobia.

Nomophobia refers to the excessive and problematic use of smartphones by individuals (Gezgin, 2017). Nomophobia reflects individuals' excessive dependence on their phones and the need to be constantly online. This may be due to the desire to constantly connect in digital environments such as social media, communication, and entertainment. Nomophobia is an anxiety disorder associated with digital addiction and can negatively affect individuals' mental and social health over time.

Netlessphobia

Netlessphobia, which is the fear of being without the internet, is defined as individuals showing withdrawal symptoms caused by digital addiction when they are without the internet. Netlessphobia refers to the discomfort and fear of being without the internet beyond the duration of internet use (Öztürk, 2015). When individuals cannot access the internet, they may have a tense and aggressive mood and may have a feeling of feeling incomplete.

Individuals with netlessphobia may show symptoms such as preferring places with internet, feeling that life stops when there is no internet, and not being able to stay away from the internet even for a short time (Öztürk, 2015). While digital environments offer individuals a space of freedom on the one hand, on the other hand, they can be addictive and put individuals under captivity (Fiske, 2003, 50-70). While individuals spend more and more time in virtual environments every day, they continue to move away from real life rapidly (Şayir, 2023).

The increasing importance of the Internet in information access and communication causes individuals to feel the need to stay online constantly. Netlessphobia is an increasing problem in our age of rapid digitalization. The intense anxiety felt by individuals in situations such as internet interruption can negatively affect both their daily lives and their psychological health. Therefore, strategies to reduce digital addiction and awareness activities are critical in dealing with netlessphobia.

Fomo

Fomo disease is a combination of the first letters of the words in the English “Fear of Missing Out” phrase group (Tekayak & Akpınar, 2017). Fomo, the fear of missing out, is the desire to be aware of all developments on social media at all times. Individuals with fomo frequently follow the agenda on social networks, share posts and spend most of their time in digital environments. According to O'Connell (2020), individuals with fomo feel obliged to follow all the content shared on social media.

Individuals who spend too much time in virtual environments live without giving due importance to their real lives (Şayir, 2023). Fomo is a very common disorder in the digital age and is associated with people's desire to maintain social ties, maintain their status, and be equivalent to others. This disorder is especially common among young people and social media users.

In the fight against fomo, individuals should limit their use of social media and participate more in offline activities. Awareness-raising activities should be carried out to regulate the structure of social media algorithms that encourage addiction and to make individuals less dependent on online content.

Plagomania

Plagomania, which is the fear of being without charge, is defined as being worried about being deprived of technological devices. Individuals with this psychology pay attention to be close to the electrical socket when they enter an environment and always carry a spare charger with them due to the fear of being without charge (Ünüvar, 2020). The basis of plagomania is the anxiety of being without communication and the anxiety of staying away from the virtual environment (Doğan & Övür, 2023).

Plagomania describes the fear or anxiety that people feel when their electronic devices, especially cell phones or other digital devices, run out of charge. Not being able to go online can cause fears such as loss of connection, deprivation of social media interactions, or loss of access to work and school-related information. For these individuals, a dead device can lead to fear of being excluded from social interactions, access to information and the digital world. This can cause individuals to constantly carry their chargers with them and look for charging points in every environment. For example, when an individual goes to a restaurant, the first thing they check is whether there is an outlet and panic when their phone's charge percentage is low is a common indicator of plagomania.

In the fight against plagomania, individuals need to question their dependence on digital devices and develop habits of spending time away from digital devices. Encouraging offline activities and learning to use technology as a tool may contribute to the reduction of such addictions.

Digital Obesity

Digital obesity is defined as excessive exposure to information in the digital environment to the extent that it may impair an individual's health. In other words, digital obesity is a condition that occurs as a result of individuals' excessive and unconscious use of digital devices and the internet, leading to mental, physical and social problems. This concept refers to the overloading of the digital world with too much information, content and interaction. As a result of excessive

consumption of digital media, the individual becomes addicted and has a desire to consume more. As a result, the individual gradually becomes digitally obese. Individuals are exposed to excess data in direct proportion to the time they spend in the digital environment. The risk of digital obesity increases as individuals, who have become inseparable from technology due to excessive use of technology, continue to consume the digital content offered (Bayrak & Cihan, 2021).

Individuals who consume excessive data and remain inactive in front of digital devices for hours feel physically and mentally tired. Digital obesity can physically cause musculoskeletal pain, eye diseases and sleep disorders (Şayir, 2023). For example, the lack of physical activity and chronic fatigue of an individual who constantly consumes content on social media is an indicator of digital obesity.

In the fight against digital obesity, individuals need to limit their digital content consumption habits and turn to conscious content consumption. Tools that control information consumption and programs that encourage individuals to participate in offline activities can contribute to solving this problem.

Online Narcissism

Narcissism is defined as self-admiration; online narcissism is defined as the desire to constantly exist and glorify oneself in the digital environment. Narcissism is also called inflated self. Individuals with online narcissism have a desire to glorify themselves in the digital environment. They constantly try to be liked by others and to appear superior to everyone on social networks. For example, an example of online narcissism is when an individual constantly posts perfect-looking photos and attaches excessive importance to the number of likes they receive on each post. These individuals try to show themselves as competent even if they do not have enough knowledge on a subject and always act according to their own interests (Topçu, 2019).

Online narcissism is a behavior and attitude disorder shaped around the desire of individuals to constantly highlight themselves on digital platforms, to be liked and approved by others. This situation increases even more with the interaction and visibility opportunities provided by social media. Online narcissism can be considered as the reflection of the classical concept of narcissism in the digital world. Balanced use of social media and strengthening ties with real life values are important steps in combating online narcissism. Social media interactions such as likes, comments and shares directly affect the self-worth perception of the individual and can lead to disappointment when they do not receive enough likes.

Online narcissists may constantly compare themselves with other users in terms of number of followers, likes or popularity. In combating online narcissism, it is important for individuals to avoid over-focusing on their image in the digital world and prioritize their real-life relationships. Social media platforms should reorganize their algorithms that encourage such behaviors and individuals should be encouraged to present a more realistic image in the digital world.

Selfitis

It is a disorder defined as taking photos of oneself frequently and sharing these photos on social media platforms. Researchers state that individuals with selfitis like to attract attention, often lack self-confidence and have characteristics that aim to strengthen their position in society. This situation arises from the person's effort to communicate better with other individuals in society.

Selfitis is considered a disease because it causes addiction in individuals, damages relationships between people, and causes people to attach more importance to their appearance than necessary (Tekayak & Akpınar, 2017). People often take photos to show themselves to others and attract attention through social media. Likes and comments on social media posts provide emotional satisfaction and cause the person to spend more time on social media. For example, a typical example of selfitis is when an individual constantly takes selfies throughout the day and posts them on different social media platforms, expecting high ratings for each photo.

Selfitis can sometimes be considered a psychological disorder, but it is also a reflection of the way people express themselves on social media in the digital age. To combat selfitis, individuals should control their use of social media and prioritize face-to-face social interactions.

Photolurking

Photolurking, a digital disease, is defined looking at other people's photos through social media platforms for long periods of time and repeating this behavior frequently. Photolurking is referred to as the act of monitoring other people's profiles and posts on social media. Photolurking is quite a common occurrence among social media users. Various psychological reasons such as internet addiction underlie this situation (Tekayak & Akpınar, 2017).

Photolurking behavior is common among people who do not want to attract attention and are passive users on social media. In addition, monitoring other people's posts in this way can sometimes be considered disturbing in terms of social media ethics, because constantly observing people's private lives can be perceived as behavior without their consent. For example, a typical example of photolurking behavior is when an individual constantly follows the luxurious lifestyles of popular people on social media platforms and compares himself to them.

Cyberchondria

Cyberchondria is defined as a behavior that occurs as a result of anxiety and negative emotions accompanying this process while conducting research on illness in the digital environment (Sen, 2023). In other words, cyberchondria, which means the search for online information about diseases, is characterized by the fact that research conducted for the purpose of providing trust increases anxiety, uncertainty and worry (Fineberg et al., 2022).

It is defined as the individual diagnosing himself/herself and trying to treat himself/herself by taking into account the information in the digital environment about the diseases that the individual thinks exist (Tarhan et al., 2021). For example, a common example of cyberchondria is when an individual with a headache searches for signs of cancer on the internet and panics, believing that they have a serious illness.

Individuals who think that they are ill search the symptoms of the disease on the internet, thinking that they will find a solution to their illness on the internet, diagnose themselves and try to find treatment methods. These individuals try to treat the sick people around them with the same method with the idea that what they are doing is right. However, they cause worse consequences due to incorrect treatment methods (Tekayak & Akpınar, 2017). Health information on the internet may not always be accurate, and as a result, individuals may be tempted to seek medical attention unnecessarily.

In order to combat cyberchondria, training programmes to increase health literacy should be organized. In addition, regulations should be made to increase the accuracy of resources providing medical information on digital platforms.

Digital Detox

While detox is generally defined as the process of abstaining from unhealthy substances and purification (Basu, 2019), digital detox refers to a situation that occurs as a reaction to information overload through digital devices (Pathak, 2016). Digital detox is a process to stay away from digital devices for limited time (Pınarbaşı & Astam, 2020). Reducing social media usage time, going offline at certain hours or switching off digital devices for a while are important steps in digital detox. Digital detox includes methods such as reducing screen time and technology use to encourage offline activities (Newport, 2022).

In recent years, digital detox practices have become widespread as people have started to feel uncomfortable with the time they spend uncontrollably on digital media (Albayrak, 2020). Digital detox has the potential to reduce the stress and anxiety experienced by individuals due to technology addiction. It can be considered as an effective tool to prevent health problems caused by staying in front of the screen for a long time. It allows individuals to engage in social and cultural activities during the time away from digital devices.

Digital detox also allows individuals to strengthen social ties by improving their face-to-face communication skills (Biricik, 2022). Dinç (2015) emphasizes that in order to prevent technology addiction, the factors that cause technology addiction should be eliminated first. These factors are the lack of sufficient environments where individuals can show themselves, participate in social and cultural activities and socialize in society. Increasing these opportunities is one of the steps to be taken to prevent technological diseases (Dinç, 2015).

An example of a digital detox is a pepper grinder produced by a pasta sauce brand. This grinder was produced to create a space away from digital connection at the dining table by disabling the internet connection. The product aims to increase social interaction among family members by disconnecting the internet connection during the meal (Pınarbaşı & Astam, 2020). Another application example is the reminder setting for social media applications to manage time. When the time set by the user in the application expires, the program notifies the person of the time spent on social media by giving a warning. In this way, it is important for the person to determine his/her social media usage habits in detail and to make self-control (Pınarbaşı & Astam, 2020).

Digital detox practices offer important strategies that enable individuals to temporarily move away from the digital world and limit their use of technology. Excessive use of digital devices negatively affects both physical and mental health of individuals and increases the risk of digital addiction. In this context, digital detox programs stand out as structures that aim to help individuals experience mental and emotional renewal by taking a break from technology for a while. According to Syvertsen and Enli (2019), digital detox allows individuals to temporarily disconnect from the digital world and refocus on real-world interactions and activities.

Digital detox is a process in which individuals step away from digital devices and social media platforms for a certain period of time to improve their mental and physical health. This process allows individuals to restructure their relationship with technology. For example, switching off one's phone and spending time in nature over the weekend is a practical application of digital detox.

Digital detox helps individuals to combat digital addiction and develop a balanced lifestyle. Educational institutions should implement programs that promote digital detox and technology companies should offer tools that take users away from the digital world. Promoting offline activities and balancing one's relationship with technology can increase the long-term benefits of digital detox. As a result, digital detox practices do not aim to completely disconnect

individuals from technology; on the contrary, they aim to establish a healthy balance. These practices help individuals to become more controlled and conscious users in the digital world and protect them from the negative effects of technology.

Conclusion

It is a known fact that digital devices provide great convenience to people's lives. Digital tools offer great advantages to users in many areas such as communication, communication, education and entertainment. However, intense exposure to digital technologies occupies minds and distracts people from the real world. Since these devices contain addictive elements, they trigger the desire for continuous use and individuals spend most of their time with these devices. The unconscious and uncontrolled use of these devices brings along many psychological problems known as digital illnesses. Nowadays, it is not possible to completely get away from digital devices, but digital detox is considered as a viable method to prevent digital illnesses. Digital detox can be defined as a break or pause in the use of digital devices.

Digital detox offers effective strategies to help individuals re-evaluate their relationship with technology and protect themselves from the negative effects of digital addiction. In today's world, where technology is integrated into every aspect of life, digital detox practices help individuals approach the digital world from a healthy distance and contribute to protecting both their physical and mental health. In this regard, it is of great importance to reorganize the time spent using digital devices.

In addition, digital device developers and platform managers should provide features that support users to use digital devices in a balanced and informed way. For example, software such as screen time monitoring and limiting can encourage users to have a healthy relationship with technology. In other words, helping individuals to become more controlled and conscious users in the digital world is important to protect them from the negative effects of technology. Developing balanced usage habits instead of completely disconnecting from the digital world is vital for individuals to lead a healthy life.

In conclusion, this study emphasizes the positive effects of conscious and balanced use of digital technologies on the physical, psychological and social health of individuals and reveals that digital detox is an effective method for the prevention of digital diseases. While benefiting from the features of digital devices that make life easier, it is necessary to develop a balanced usage habit to protect against the negative effects of digital diseases. This study is a resource that can contribute to raising awareness of individuals in the fight against digital diseases and raising awareness throughout the society.

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