2023

Volume 16, Issue 3
Cilt 16, Sayı 3

Kuramsal
Eğitimbilim Dergisi
JOURNAL OF THEORETICAL EDUCATIONAL SCIENCE

Afyon Kocatepe University
Faculty of Education

ISSN: 1308-1659

http://www.keg.aku.edu.tr

Eğitimbilim

Kuramsal

KURAMSAL EĞİTİMBİLİM DERGİSİ*
Journal of Theoretical Educational Science
ISSN: 1308-1659

Publisher
Afyon Kocatepe University

Owner
Dr. Ahmet Ali GAZEL (Dean) on behalf of Afyon Kocatepe University

* **Journal of Theoretical Educational Science** is a quarterly peer-reviewed online journal.

Abstracting and Indexing
ERIC, ULAKBİM TR Dizin, EBSCO, ERIH Plus, DRJI, DOAJ, Türk Eğitim İndeksi (TEİ), SOBIAD

Redactions
Res. Asst. Merve VEZİR

English Language Editor
Res. Asst. Gamze KAPUCU

Address
Afyon Kocatepe Üniversitesi, Eğitim Fakültesi, A.N.S. Kampüsü, 03200 Afyonkarahisar, Turkey
Tel: +90 272 2281418
e-mail: editorkebd@gmail.com

CONTENT

FROM THE EDITOR

Dear Colleagues,

The *Journal of Theoretical Educational Science* is happy to publish the third issue of 2023! In the July issue of 2023, we have been publishing 10 research articles from 19 authors. We are glad that these articles represent the different disciplines of education.

We should also express our sincere thanks to the Editorial Board, reviewers and authors for their invaluable contributions.

We look forward to receiving submissions from different parts of the world!

Kindest regards,

Fatih GÜNGÖR, PhD
Afyon Kocatepe University
Faculty of Education

Journal of Theoretical Educational Science, 16(3), 482-501, July 2023
Kuramsal Eğitimbilim Dergisi, 16(3), 482-501, Temmuz 2023
[Online]: http://dergipark.org.tr/akukeg
DOI number: http://doi.org/10.30831/akukeg.1219475

Changing Landscapes of Teacher Quality in Initial Teacher Education: Examples from Scotland and Turkey

Öğretmen Yetiştirme Programlarında Öğretmen Niteliğine İlişkin Değişen Görüşler: İskoçya ve Türkiye'den Örnekler

Bilge ASLAN ALTAN* **Sinem HIZLI ALKAN****

Received: 15 December 2023 **Research Article** **Accepted:** 25 April 2023

ABSTRACT: Teacher quality has attracted much attention both conceptually and empirically, especially in tackling some global challenges. Initial teacher education (ITE) has historically been one of the key actors in developing teacher quality and one of the foci in research. The article contributes to these debates by comparing two ITE programmes, from Scotland and Turkey, which have been recently reshaped. Both countries have currently declared new reformative steps and introduced internationally cared new conceptions into teacher quality. This study utilized a comparative approach and document analysis to investigate the evolution of views on teacher quality in different countries. The findings provide insights into the changes that have occurred in each country's perspective over time. ' Drawing from the two contexts, the paper sought evidence in articulated reports for core values and capacities, digital transformation, teacher agency, and innovative and inclusive pedagogies, which are considered important elements of the teaching profession in related literature. Followingly, the study outlines and compares the decisions and intended actions of these two contexts in terms of similarities and discrepancies under the aforementioned four indicators that can be both an example for international ITE programmes and a road map for teacher quality in ITE curricula design. By comparing two examples of ITE programmes with the suggested indicators of teacher quality, we would like to extract insights to reconsider and re-conceptualize teacher quality in much wider literature and future research.

Keywords: Teacher quality, professional competencies, initial teacher education, Scotland, Turkey.

ÖZ: Öğretmen niteliği, özellikle bazı küresel zorlukların üstesinden gelmek için hem kavramsal hem de uygulamalı çalışmalar kapsamında oldukça dikkat çeken bir konu olarak yorumlanmaktadır. Öğretmen yetiştirme süreci, tarihsel olarak öğretmen niteliğini geliştirmede kilit aktörlerden ve araştırma odaklarından biri olarak karşımıza çıkmaktadır. Bu durum, öğretmen yetiştirme sürecinin uluslararası düzeyde reformlaşma ve niteliği arttırmada bir yol haritası belirlemede, karşılaştırmalı araştırmaları sıklıkla görmemizin nedenleri arasında sayılabilmektedir. Bu çalışma, son zamanlarda öğretmen yetiştirmeye yönelik reformlar başlatan İskoçya ve Türkiye'den iki örnek sunarak bu tartışmalara katkı sağlamayı amaçlamaktadır. İki farklı içerikten yola çıkan araştırmada, bahsi geçen iki ülkenin yakın zamanda yayınladıkları reform raporlarını inceleyen doküman analizi kullanılmıştır. İlgili resmi raporlarda, öğretmen yetiştirme süreçlerinde evrensel nitelikte vurgulanan, çekirdek değer ve beceriler, dijital dönüşüm, profesyonel yararlılık, yenilikçi ve kapsayıcı pedagojiler olmak üzere dört temaya ilişkin ipucu ve kanıt aranmıştır. Analiz sonucunda, iki ülkenin ilgili temalarda benzerlik ve farklılıklarına ilişkin karar ve niyet edilen eylemleri açıklanmış ve karşılaştırılmıştır. Araştırmanın sunduğu ve öğretmen niteliğini ilgilendiren dört temasının ve rapor bulgularının hem uluslararası düzeyde öğretmen yetiştirme programlarına örnek olması hem de program tasarlama aşamasında öğretmen niteliği bakımından yol gösterici olması beklenmektedir.

Anahtar kelimeler: Öğretmen niteliği, mesleki yeterlikler, öğretmen yetiştirme, İskoçya, Türkiye.

* *Corresponding Author:* Dr, Muğla Sıtkı Koçman University, Turkey, bilgeaslan@mu.edu.tr, http://orcid.org/0000-0002-3309-933X
** Dr., Anglia Ruskin University, United Kingdom, sinem.hizli-alkan@aru.ac.uk, http://orcid.org/0000-0003-0694-4160

Citation Information
Aslan Altan, B., & Hizli Alkan, S. (2023). Changing landscapes of teacher quality in initial teacher education: Examples from Scotland and Turkey. *Kuramsal Eğitimbilim Dergisi [Journal of Theoretical Educational Science], 16*(3), 482-501.

ISSN: 1308-1659

Teachers' professional competencies have been prominent underlying indicators of teacher quality, which is an ever-shifting concept (Cochran-Smith, 2021). Initial teacher education (ITE) has historically been a key factor in equipping prospective teachers with professional competencies and engaging in ongoing debates for improvement (Darling-Hammond, 2020; Estellés & Fischman, 2021). Hence, ITE programs worldwide have witnessed ongoing reforms to improve teachers' different competencies (pedagogy, technology, content knowledge, career development, etc.) for enhancing teacher quality. Scotland and Turkey, despite being context-specific, can serve as excellent examples of recent reform efforts in initial teacher education. Both countries have revised their ITE curricula, providing valuable insights into effective design practices.

Teacher quality, as a concept, can be linked to several indicators and complex dynamics, and ITE programs are expected to promote most of them (Birch et al., 2018). The underpinning indicators of teacher quality, such as professional competencies, can act as a starting point to define basic standards and expected outcomes of ITE programs, to organize practicing and mentoring, to design assessment criteria for recruitment (Guarino et al., 2006), and to assist novice teachers in their early career. These indicators, which are associated with different aspects of ITE programs, are assumed as critically important in promoting teacher quality (Darling-Hammond, 2021) and continually emphasized in reformative actions of ITE programs.

While reforming ITE programs to meet national needs and cultural circumstances, it is important to consider internationally accepted issues related to teacher quality (OECD, 2019) when designing a framework. While nations reshape their own unique programmes and rethink their teacher quality, they tend to follow international represents of the educational ecosystem. Therefore, each jurisdiction often harmonizes global trends and circumstances with their local manoeuvres because science, economy, technology etc., affect human-driven needs and expectations. This is one of the reasons why we see increased impetus in reform agendas to shape ITE programs internationally and also comparative research to identify some roadmaps to better equip teachers.

Against this backdrop, drawing inspiration from successful teaching practices internationally is important. However, it is equally important to conduct comparative analyses of research and reports to identify potential drawbacks that may prevent teachers from becoming competent. The indicated drawbacks are mostly gathered around pre-and-in-service teaching competencies, practices, and the structure of ITE programs. Consented evidence of studies (Benavides et al., 2020; Berkovich & Benoliel, 2020; Flores, 2020; Goodwin, 2020) and reports (OECD, 2019) are reflected as follow:

- Prospective teachers may exhibit a lack of core values and competencies of being a teacher because ITE programs mainly concentrate on technical aspects of teaching. This downgrades pedagogy into a set of techniques and approaches which ultimately risk to detheorise and deskill teaching profession.
- International policies, theoretical and empirical studies, and good examples in teacher education are rarely taken into consideration and/or valued enough by the official institutions and associations. Therefore, reformative steps may not be efficient in program revision.

- Lack of interconnection and cooperation among national and international teacher education institutions and associations may hinder effective adaptation of contemporary competencies in ITE. This may risk addressing global challenges such as technological, social, environmental, and economic at the international and national levels.
- Theories in ITE programs, prospective teachers' beliefs and perceptions towards teaching, and the perceived gap between theory and practice may result in problems in real teaching environments. Hence, prospective teachers can have "reality shocks" in a real classroom environment, especially in their early careers.
- Not acknowledging national and international challenges and dynamics in the curriculum design of ITE may result in insufficient and unsustainable practices, content coverage, values, and competencies.
- The productive power of technology adaptation and the use of digital tools in teaching and learning environments can be underestimated in designing ITE programs so that prospective teachers and in-service teachers can sweat with anxiety about digitally-enhanced teaching and/or digital-based pedagogies.
- ITE programs struggle to foster teacher agency which may generate difficulties in envisaging different possibilities, especially in unexpected situations (e.g., COVID-19).

Although the importance of teacher competencies as part of teacher quality is cited among scholars, the subsequent regulations and practices depend mainly on national contexts (Cochran-Smith, 2021; Snoek, 2021). The way national systems conceptualize teacher quality influences policymakers, teacher educators, and other accompanying stakeholders in ITE to administer teacher education processes, overcome new challenges, and be ready for future expectations and dispositions. Consequently, ITE programs take different stands and forms with diversified adaptations of global debates around teacher quality. These differences include different components of ITE programmes, such as criteria for selection (Flores & Niklasson, 2014), how they comply with professional standards, in-service training procedures, adopted pedagogies, practices, graduation requirements, induction, and many other can vary among nations. It is essential to map out different trajectories that countries take to shed light on ongoing debates around the need for a framework for teacher quality (Olsen, 2021) that can be adapted to different countries. Leaning on the idea that crossing contexts and studies in ITE has the power to identify and empower teaching quality in a wider sense, our paper examines Scotland and Turkey to address this issue by *1) describing the development of ITE programs in Scotland and Turkey briefly, 2) comparing these programs in terms of promoted teacher competencies under four indicators (core values and capacities, digital transformation, teacher agency, innovative and inclusive pedagogies), and, 3) offering these four key indicators that are intended to contribute to the literature on consented drawbacks of pre-and-in service teacher education and that can be adapted according to different national contexts.* Drawing from our analysis of recent developments in Scotland and Turkey, our paper aims to reflect on how these indicators are integrated into ITE programs in these contexts. Although there are evolving national and international components of teacher education and teacher quality, we seek to understand and discuss how these two contexts incorporate globally

studied issues into their ITE curricula and provide insights for ITE programs seeking change.

The Context of the Study: ITE in Scotland and Turkey

Scotland offers four-year undergraduate ITE programs and some one-year Post Graduate Certificate in Education (PGCE) courses through accredited universities. There is no prescribed ITE curriculum at the national level. However, a set of professional standards outlines competencies that prospective teachers are required to demonstrate by the end of their ITE program. The General Teaching Council for Scotland (GTCS), which is an independent body, sets the standards and accredits education institutions. These standards were revised in 2021 and were enacted after August 2021. Three categories outline the standards: Being a Teacher in Scotland; Professional Knowledge and Understanding; and, Professional Skills and Abilities. These standards provide a starting point and a framework for educational institutions to design their curriculum. Consequently, each institution may have different modules and organization of content in different ways.

The GTCS published a guideline for initial teacher education programs in Scotland in 2013 (an updated version is expected later in 2021). This document outlines several points, such as the aims of teacher education and requirements for programs to be accredited. These standards and guidance shape the making of the ITE curriculum while leaving space for flexibility for teacher educators.

The Scottish Government (2017) published a report to map the content of ITE programs. Seven ITE providers were examined by looking at both the undergraduate degree programs and PGDE programs. The report outlined an overview of the number of hours of contact allocated to literacy, numeracy, health and wellbeing, equality, and data literacy (the core areas of the Scottish Curriculum for Excellence). Moreover, elective study programs, assessment methodology, and pedagogy were also included in the scope of this review.

ITE programs in Turkey were developed by the Higher Education Council (HEC) until 2020, during which the education faculties were authorized to design their own curricula for teacher education. Until then, HEC was responsible for decision-making in the design and revision of ITE programs. These programs were (still are) structured in three dimensions: general knowledge, content knowledge, and pedagogical competencies. In addition to core dimensions for teacher education, there is also a report as Teacher Competencies Framework declared by the Ministry of National Education (MoNE) in 2006 and revised in 2017 to follow certain teacher qualifications sought in prospective teachers. This report outlines general standards and competencies for pre-and-in-service teachers.

In occasionally revised programs, HEC tried to follow international trends in teacher education policies and competencies as well as nation-based reforms. Particularly, during the EU accession period, ITE programs and studies were greatly influenced by European policies and competencies in teacher education. Content and crediting have been revised in Turkish ITE programs to be consistent with ITE programs around Europe. Referenced and suggested trends in pedagogy were varied with elective courses and content in core courses. With the final decision, offered courses in pedagogy were settled as %30-35 of the initial teacher education program,

and some of the courses were renamed and updated. Throughout the revision studies, education faculties could increase/decrease the percentage of the related courses and add/vary similar courses; yet they cared about the references offered by HEC.

The most recent move of HEC, which delegates the authorization in designing authentic curricula for ITE programs to faculties of education, is expected to improve teacher quality by following national and international needs and trends while training prospective teachers. This manoeuvre can enhance teacher competencies as long as it values the core dimensions, local and global trends, and emerging needs that are able to contribute to outlined teacher standards.

With the new decision of the Higher Education Council, the education faculties have the autonomy to design their own ITE programs according to their own priorities. After delegating authority, some education faculties have started developing their own programs. However, it is still incomplete how education faculties conduct their own curriculum development procedure since it is a brand-new issue. Considering curriculum making is a dynamic procedure, authorized faculties should cooperate in many decisions and actions such as research, selection criteria, expected values and competencies in teaching, graduation qualifications, recruitment, early career development, etc. Besides nationwide cooperation, experts and decision-makers should value international cooperation and effective policies/implementations to adapt global changes, trends, and future directions into national contexts.

Method

As illustrated in the above sections, there is an increasing interest in exploring and comparing international trends, discourses, and practices to inform future developments in teacher education (Menter & Flores, 2020; Olsen, 2021). Our main aim in this paper is to examine how professional competencies are presented and promoted in the national documents of initial teacher education in Scotland and Turkey and to offer a roadmap to be utilized internationally. In doing so, the study is designed as comparative research while employing a document analysis as a method.

Comparative Research

Comparative research, which can be renamed as comparative approach, education, analysis, study, etc., has been valued to concern about a phenomenon of a different culture/nation (Phillips, 2006). Therefore, there have been disputes among researchers about distinguishing certain assets in a systematic way. Education, in particular, is one of the social sciences in which various problems exist, and it is not truly possible to select the best way to make comparisons and inferences (Noah & Jennifer, 2013). Together with other scholars, Bereday (1964) also offers a perspective, and following steps that can match with a systematic document review procedure in a comparative study of education. According to the model of Bereday, researchers should first describe the phenomena and collect data; then interpret what the documents present; continue to juxtapose with comparison through leading concepts; and finally, compare the countries' data in line with the research intention and draw conclusions for future acts.

Drawing from Bereday's model, we followed similar steps in this research. First of all, the literature on teacher education and teacher quality was reviewed, then

emerging themes for present and future teacher competencies were listed. Believing that teacher education is a system starting with selection and continues till early career support, we filtered the listed themes and narrowed down the leading concepts of comparison. Subsequently, the paper offers the following four indicators (which are explained in detail in the following sections) of teacher quality in teacher education:

- *Core values and competencies*: They refer to "being a teacher" and expected skills for future teachers.
- *Digital transformation*: It refers to one of the hot topics of the educational ecosystem in which digitally enhanced teaching actions and skills are frequently and pointedly emphasized.
- *Teacher agency*: It refers to both the individual capacity to act and also ecologies (structural and cultural factors) that support or hinder teachers' actions
- *Innovative and inclusive pedagogies*: They refer to pedagogies that can be adapted to students' diverse backgrounds and potentially promote social justice

In the following steps, selected documents were reviewed and interpreted.

The Data and Analysis

In this research, we examined official reports on teacher education. These reports were published by the two countries' authorized bodies, namely GTCS for Scotland and HEC and MoNE for Turkey, to declare reforms on teacher education and teacher quality/standards. Table 1 presents the documents included in our analyses. These documents comprise the framework for ITE providers to design their curricula.

After accessing the data, each researcher initiated the first round of analysis. More specifically, the data were sorted according to the titles defining the expected teacher qualities. The repeated and underlined keywords that emerged in these documents were listed for each context. This stage was also helpful in introducing the contexts of this study to the readers. In the second round, the documents were shared with two curriculum and instruction experts (also lecturers) from each context as part of peer scrutiny; then, the listed keywords were extrapolated. Examining the raw data, we first compared the main tenets of the promoted professional competencies underpinning teacher quality in both contexts.

In terms of the main tenets between the two countries' reports, we conclude that the two contexts share some commonalities and differences. Major changes in the two countries, Scotland revising professional standards and Turkey empowering universities as ITE providers to be flexible, meaning that there are upcoming potential changes in ITE curriculum-making practices. These practices would include updating their content, adding different modules if necessary, highlighting different values and practices more than others, and subsequently promoting certain professional competencies. Another similarity shared by the two contexts is that ITE providers are flexible in designing their curricula following the recent changes in Turkey. Nevertheless, certain frameworks need to be considered in this process. It is important to reveal some of the key messages promoted in these documents regarding professional competencies that will ultimately shape how ITE curricula are designed. Drawing from international research, our paper also aims to map potentially missing or under-emphasized areas to inform future practices in both countries and for others.

Table 1

ITE Related Documents Analysed

Countries	Documents	Brief outline of the framework	Underlined keywords emerged in the documents
Scotland	The Standard for Full Registration - https://www.gtcs.org.uk/web/FILES/Professional-Standards/Standard-for-Full-Registration.pdf Literature Review on Teacher Education Entry Requirements - http://www.gtcs.org.uk/web/FILES/research/GTCS-Literature-Review-on-Teacher-Education-Entry-Requirements.pdf	Professional values: Social justice, trust, respect, integrity Professional Knowledge and Understanding: Curriculum and pedagogy, professional responsibilities, Professional Skills and Abilities: Curriculum and pedagogy, the learning context, professional learning	Social justice, diversity, inclusion, equity, teacher agency, global educational and social values, children's rights, learning for sustainability, teachers' strong moral and ethical principles and values, collaborative professional learning, leadership of learning, a variety of pedagogical approaches, research and practitioner enquiry, curriculum design, digital literacy and digital technologies, additional support needs, assessment, legislations, national and international education systems, learning communities, differentiation, progression, nurturing and positive relationships with colleagues, parents, and students, learner participation, research-informed decisions, Reflective and critical practice
Turkey	Initial Teacher Education Curricula - https://www.yok.gov.tr/Documents/Kurumsal/egitim_ogretim_dairesi/Yeni-Ogretmen-Yetistirme-Lisans-Programlari/AA_Sunus_%20Onsoz_Uygulama_Yonergesi.pdf General Competencies for Teaching Profession - http://oygm.meb.gov.tr/meb_iys_dosyalar/2018_06/29111119_TeachersGeneralCompetencies.pdf National Document of Teacher Strategy http://oygm.meb.gov.tr/meb_iys_dosyalar/2017_07/26174415_Strateji_Belgesi_RG-Ylan-_26.07.2017.pdf	Professional Knowledge: Content knowledge, pedagogical knowledge, knowledge on legislation Professional Skills: Planning of education and teaching, creating learning environments, managing the teaching and learning process, assessment and evaluation Attitudes and Values: National, moral, and universal values, approach to students, communication, and cooperation, personal and professional development	Subject area, fundamental theories and approaches, information and data sources, national and moral values, research methods and techniques, curriculum, child development and learning styles, teaching strategies, methods and techniques, assessment methods, individual rights and responsibilities, accounted legislation, rights, and responsibilities of educational stakeholders, flexibility, individual differences and sociocultural characteristics, material development, effective communication, time management, locality, cooperation, child and human rights, cultural differences, universal values, environment, historical and cultural heritages, role modelling, empathy, school development, ethics

As part of the final analysis, we compared the two contexts referring to four indicators as *core values and competencies, digital transformation, teacher agency, innovative and inclusive pedagogies* that we believe capture the essence of the commonalities and differences between Scotland and Turkey are identified. These indicators are also presented and discussed as a framework to reflect on international ITE curriculum changes to tackle global challenges and develop teacher quality. Next section will examine these interrelated indicators with references to the two contexts of this research and wider to shed light on the future developments in ITE.

Results

Following sections will explain each indicator and make links to Scotland and Turkey. These components are dynamic entities that interact with each other to generate a framework that can be used as a starting point for rethinking ITE curricula internationally. We aim to illustrate how these components may shape the upcoming ITE curricula developments in both contexts and also draw some conclusions that can be mobilized to different settings.

Core Values and Competencies

Generally, teaching is considered a highly prestigious profession among people. While intending to be a teacher, this perception may even seem as a criterion. However, it is not the case in all countries or national contexts. Not every prospective teacher can have internal motivation to truly feel as a teacher and/or understand a teacher's responsibilities (Flores & Niklasson, 2014). In this case, ITE programs are expected to comprise persuasive content to make prospective teachers deeply understand what being a teacher means at heart and what responsibilities a teacher should have. The recent updates in the documents of Turkey trend in empowering the professional status of teachers. This effort is infused into ITE programs by re-determining selection criteria and assuring teacher quality with revised program structures. The academic success determined with the national standardized test scores has been increased for the entry to education faculties, and the accreditation process has been initiated for ITE programs. However, there is no official report to prove successful results of these steps yet.

Although we see similar trends in Scotland, such as emphasizing professional values and professionalism, how these are sought to be achieved seem to be different. While Turkey pays more attention to the selection criteria and proposes some changes in the list of content to be taught, Scotland tends to offer a comprehensive vision and more nuanced insights regarding the professional values, which are located at the heart of 'Being a Teacher in Scotland' (GTCS, 2021a). For example, the social justice aspect is an overarching theme in Scotland, while this aspect is not clearly stated as a theme in the analysed documents of Turkey. Although there is not a direct reference to this theme, social justice is briefly explained as one of the reasons to update Turkish ITE programs to raise awareness among prospective teachers, and is included as a theme in a new must course "Morals and Ethics in Education". It would be much better to evidently see justified values and core dimensions to refer to apparent changes in line with the professional development of the new reforms in Turkish ITE programs.

The 21st century has brought additional insights into teaching competencies worldwide apart from the already established ones (Tican & Deniz, 2019). Becoming more interconnected, teachers have been introduced to new concepts such as being a global citizen, addressing social justice issues, being aware of global challenges, etc. Additionally, the sense of being a teacher has evolved in these new concepts and taken more competitive and affectionate responsibilities for teaching practices. Consequently, ITE programs have started to adopt a universal vision of a teacher with a global perspective and teaching skills (Bozkurt, 2020; Darling-Hammond, 2006). In such a vision, there is this intersection of global and local contexts, named "glocality" (Zhao, 2010; Goddard, 2005), which summarizes the present and future disposition of core values and competencies delineating teacher quality.

In a local sense, classrooms, real teaching environments, are very dynamic, with many challenges. These challenges become more compelling with internationally introduced new concepts. Though teaching practices are maintained in local contexts, ITE programs need to prepare teachers to combine authentic teaching contexts with these new concepts, which are agreed to be global cores of present and future education systems (OECD, 2019). Concepts such as multiculturalism, ethnic diversity, social justice, critical thinking, and entrepreneurship, as well as global phenomena such as health, technology, environment, democracy, human rights, and citizenship, are no longer regarded as "others" issues. Therefore, literature (Estelles & Fischman, 2021; Pushpanadham, 2020) supports the idea that teachers should be prepared for these concepts and issues to facilitate teaching and elaborate them within international and national contexts. Inspired by these new concepts, ITE programs in Turkey have extended teachers' general competencies in the attitudes and values domain. Accordingly, Turkish programs are to be designed with attaching more importance to globally-declared values as well as national and moral ones, which mark children's and human rights, individual and cultural differences, environment and sustainability, preserving cultural and historical heritages, etc. Although the intention of value-added competencies is clearly outlined in Turkish documents, the answer to how ITE programs will respond to it remains unknown.

Digital Transformation

Digital transformation is one of the rapid changes the world has gone through. As in every field, digital transformation happens at all levels of education, in teaching skills and learning environments of today (Falloon, 2020), and so policies in education are also highly affected. The revised standards released by the International Society for Technology in Education (ISTE, 2017) summarize the competencies for prospective teachers to design and practice learning environments with digital tools. Therefore, products and structures in instruction have been still evolving with digital technologies (Balyer & Öz, 2018) and continue to require new priorities in teaching skills as well.

Recently experienced earth-shaking pandemic and its global effects on education have flashed on emergent needs of teachers' skills and competencies in how to use technology in education, be capable of instructional technologies, and adapt them in teaching (König et al., 2020; Lynch, 2020). Digital technologies have become an inevitable part of teacher quality to maintain effective teaching and leverage learning outcomes.

With such experiences, technology has been asserted as one of the dynamic components of teacher competencies for quite some time (Hicks, 2011; Sr.-Clarke & Zagarell, 2012). In this respect, digital transformation seems to continue in future education processes, and consequently, teachers' competencies in technology are no longer a demand but a must (Gudmundsdottir & Hatlevik, 2018). To fulfil this necessity, ITE programs generally offer courses for prospective teachers on enhancing digital technologies for instruction. However, there is a growing need to add complementary content (Borthwick & Hansen, 2017) in which prospective teachers can produce their own materials, deliver the context, assess performance, and maintain teaching and learning outside the classroom (in virtual classrooms).

In Scotland, digital technologies constitute an important part of the Professional Knowledge and Understanding that teachers are expected to meet (GTCS, 2021a). In fact, the Scottish Government published a national strategy to support teachers in 2016 (Scottish Government, 2016). This strategy illustrates that digital transformation is well underway, and ITE programs are placed to offer relevant content to further support prospective teachers in achieving these aims. Although there may not be a specific module devoted to digital technologies, it is a requirement for ITE programs to cover different aspects of digital technologies as well as digital literacy elements in most of the modules so that prospective teachers can achieve related standards.

In Turkish ITE programs, there is one and only technology-based offered must course: Instructional Technologies. The content of the course basically covers introductory technology and generic digital knowledge with little essence of pedagogy, and there is no satisfactory indicator of increasing and/or enhancing related courses, content, or further policies. While analysed documents emphasize digital competencies and skills in teacher quality, reforms on technology are harmonized mostly with in-service teachers' professional development. ITE programs, therefore, teacher educators, stand-alone in improving prospective teachers' digital competencies now and then.

Teacher Agency

Teachers are offered more flexibility to adapt curriculum, for which they need some specific expertise, capacities, and supportive and nurturing environments (Sinnema & Aitken, 2013). Even in most centralised education systems, teachers always find ways to mediate their practices to respond to local needs, their students' needs, or external pressures (Sivesind et al., 2013). Teacher agency, a phenomenon achieved in a complex interaction between personal, structural, and social factors, is a key concept to understanding to what extent and how teachers can use that flexibility (Priestley et al., 2015). The notion of teacher agency is attracting much attention globally (OECD, 2018), in Scotland (Hizli Alkan, 2022), and also in Turkey in recent years (Gülmez, 2019) Following Priestley et al.'s (2015) ecological approach we understand teacher agency as something that is informed by personal and professional experience, oriented towards the future with values, beliefs, aspirations, and enacted in certain situations. Hence, it is identified as one of the central indicators of professional competencies underpinning teacher quality. Considering the fluid times, we are in an ongoing global challenge, which requires teachers to think and do differently to respond to the continued changes, there needs to be increased attention to how teacher agency is fostered in ITE curricula.

Because teacher agency is not solely about individuals' innate capacity (Priestley et al., 2015), there is a strong chance to enhance students' repertoire and offer them meaningful educational experiences so that they can achieve their agency in different circumstances. Although Scotland's new standards (GTCS, 2021a) have a reference to teacher agency, in Turkey and in general, there is still a lack of attention and a need to foster this notion in ITE curricula.

More specifically, collaboration and enquiry have been identified as two ways of developing teacher agency in the context of Scotland, whereas in Turkey, there is no specific reference made in the analysed documents. Scotland's ITE curricula are expected to achieve the standards that mention critical and reflective questioning and

engagement with educational policy and practice and, doing so, challenging some assumptions and professional practice, which are linked to the notion of teacher agency. Moreover, teachers are offered flexibility for curriculum making in their unique contexts, meaning that ITE curricula promote adequate knowledge, skills, and attitudes through benchmarking to the standards. Turkey, on the other hand, does not specifically have the notion of teacher agency. Teachers are encouraged to deliver the curriculum rather than be flexible with it. However, the recently introduced School Improvement Model in the documents somehow heartens teachers to reconsider curriculum adaptability and standard educational policies in favour of local needs and sources. It is wished to draw more attention to teacher agency in the policy of teacher quality and ITE in Turkey.

Innovative and Inclusive Pedagogies

Pedagogy, the core of teaching, is often downgraded to a set of skills and strategies following rather a technicist approach (Giroux, 2008). This may also be projected in the design and content of the related modules in ITE. Further, there is a need for a more nuanced and sophisticated understanding of pedagogy for teachers to become critical, context-sensitive, innovative, inclusive, and research-informed (Baker-Doyle, 2019; Guðjónsdóttir & Óskarsdóttir, 2020; Philpott, 2014). Hence, there is a strong potential for ITE to address these points by strengthening and enriching pedagogy-related content and practices.

Innovative and inclusive pedagogies, such as co-creation (Maloney et al., 2019) and culturally relevant pedagogy (Allen et al., 2017), aim to facilitate learning so that students are empowered with knowledge and skills to address and cope with global and local challenges effectively. These pedagogies are mainly emerged after technological advancements (Baran et al., 2017) and as a response to the global, social, and environmental crisis (Boylan & Woolsey, 2015). Moreover, recent international discourse (e.g., 21st-century skills) and policy point out a need to match current teaching practices with the agenda set by different transnational organizations, such as the OECD (Guerriero, 2017). Hence, ongoing changes and developments diffuse into teaching practices, and ITE plays a key role in taking this responsibility, partly by paying special attention to innovative and inclusive pedagogies.

Scotland offers good examples regarding this theme by emphasising the importance of inclusion, sustainability, and social justice elements of pedagogy, which is one of the core elements of professional standards (GTCS, 2021a). For example, Learning for Sustainability and Global Citizenship have been two key themes in ITE programmes, that offers a context for prospective teachers to develop and apply their pedagogy in innovative and inclusive ways. In fact, GTCS proposes that Learning for Sustainability underpins the professional standards as an intersected theme (GTCS, 2021b).

Turkey also values pedagogy-based trends in ITE programs and offers a variety of central courses of innovative pedagogies, yet it is still limited to subject-based pedagogies. As one of the developing countries where cultural and socio-economic backgrounds are diversified, Turkish ITE programs continuously emphasize inclusion in addressed teacher behaviours (MoNE, 2017). Although, in analysed documents, the emerging needs for revision of ITE programs are justified with such backgrounds, there

is no direct reference for published teacher competencies. Besides, with the increased population of immigrants and refugees that settle down in Turkey, there are new regulations for teachers to extend the rights and opportunities of immigrant students in schools (MoNE, 2017). While such circumstances should prompt policies and ITE programs to clearly define the pedagogical patterns of teacher education processes, the related documents inadequately address the themes of innovative and inclusive pedagogies. Innovative and inclusive pedagogies are important not only because they address global and local challenges but also because their context-sensitive and research-informed nature is key in developing teachers professionally (Tatto, 2021). The more teachers engage with such pedagogies and discussions around context, research, learning theories, and application practicalities; the more teacher agency will be fostered (Priestley et al., 2015). Consequently, teachers will be in a strong position to manoeuvre their practices in unprecedented times.

Discussion and Conclusion

The compared countries have recently introduced new pathways for ITE and, therefore teacher quality. As an overview, Turkey, with the delegation of authorization in the curriculum design of education faculties, seems to enable local needs to be met by the local ITE providers. Yet, it may also undervalue the national and international standards of teacher quality as a whole. Additionally, education faculties are independent bodies of each university, and it can be very challenging to figure out what is more urgent in reform actions. On the other hand, Scotland appears to follow some emerging international trends and outline teacher professional standards, offering a roadmap for revising ITE curricula.

To continue in detail, we have summarized the key professional competencies from ITE documents in Scotland and Turkey and examined them in more detail in relation to the four indicators we proposed in this paper. Drawing upon Scotland and Turkey, we outline some implications for ITE curricula internationally.

The concepts on which our present literature debates address many aspects of teacher quality. The ongoing issues of students' success (Canales & Maldonado, 2018; Harris & Sass, 2011), digitally-enhanced teaching practices (Benavides et al., 2020), environment and sustainability (Walshe & Tait, 2019), inclusion (Watkins & Donnelly, 2014; Symeonidou, 2017), and varied hot topics (will be) asserted in national and international contexts are (will be) sorted out with teacher quality. Empowering teacher quality in a systematic way, ITE programs are referenced to offer primary values and competencies which share clues about what to do and how to do it as a teacher.

Prospective teachers, each representing their unique social and cultural background, advance in teacher education programs with both national and international driving forces. Although teaching is often seen as an individualized profession, becoming a teacher is challenging, complex, and an ongoing process, and there is no single prescription for this dynamic journey. To improve, in ITE programs, teacher educators can support prospective teachers with core values and competencies, such as focusing on social justice and learning for sustainability, at a certain level since these are rarely developed in isolation. Without being aware of this global reality, teachers may have lower efficacies in maintaining teaching and bringing success. It is reasonable

to present nationally and internationally available and useful values and competencies before saying farewell to novice teachers.

The captured literature on digital transformation broadly explains how essential the digital competencies of teachers are. Unfortunately, there are still misunderstandings in training digitally-enhanced teachers of ITE programs (Alibrahim, 2020; Foulger et al., 2020). In order to improve prospective teachers in digital skills and competencies, Foulger and her associates (2020) accentuate that ITE programs are expected to infuse technology more than simply introduce it with limited technology-based courses and discuss the advantages. Rather, technology should be inspired by integrating curriculum and pedagogy across teacher education periods. It is necessary to remember that design designing and practicing digitally enhanced teaching and learning activities has a broader conception than being active users of web servers or "smart" things.

Digitalization is not limited to available digital agents in education. In this digital world, teachers as individuals should be aware of new terms such as digital identity, digital community, digital security, digital games, and so on. Besides, using digital technologies and agents does not necessarily mean that learning effectively and continually occurs. Applying digital technologies in teaching and learning may not positively affect student engagement or high success in student performance. In such cases, teachers should be able to use technology to overcome any challenge, which represents the notion of "professional digital competence" of Intesfjord and Munthe (2018). Teachers can gain different digital competencies as generic digital competence (Aslan & Chang, 2017), digital teaching competence (Gudmundsdottir & Hatlevik, 2018), and professional digital competence (Instefjord & Munthe, 2017) throughout their initial teacher education and can supervise these competencies and skills while practicing.

In terms of teacher agency, at least four areas can be identified where teachers may lack certain skills in order to learn about their agency and how to bring it into action; developing educational discourse, critical and reflective thinking, rich repertoire to envisage different education possibilities, and constructing supportive learning networks (Hizli Alkan, 2021; Priestley et al., 2015). First, educational discourse is important as it can frame how teachers think about the purposes of education in general, and their beliefs about students and learning. Developing critical and rich educational discourse will better position teachers to challenge, for example, policy discourses and ask deeper questions to prevent superficial implementation of curriculum policy. This is much needed as countries often tackle the issue of the curriculum implementation gap, partly due to a lack of teachers' sense-making (Pietarinen et al., 2019). Second, critical and reflective thinking, which is tied into the first area, is crucial for engaging with educational policies and different initiatives for continuous and meaningful development. Teachers matter in line with much of curriculum policy discourse, and they are the key actors in educational change. However, their agency will be limited without equipping them with critical and reflective thinking. Third, there needs to be space and support given to develop repertoires, including research, pedagogy, and assessment, to envisage different education possibilities. This is particularly important during uncertain times. Finally, supportive learning networks that will offer rich insights and resources to think deeply about education and change are essential to foster teacher

agency. ITE programs should begin to consider these areas by examining the design and content of the programs.

As a final point, ITE programs need to consider moving away from solely teaching a set of strategies in a technical manner to creating opportunities for pre-service teachers to explore their personal and professional identities to bring about social justice and change (Boylan & Woolsey, 2015). Although the social justice element in ITE has been a focus in some countries, including Scotland (GTCS, 2021a), it is still an underemphasized dimension elsewhere (e.g., Turkey). We argue that innovative and inclusive pedagogies offer an opportunity to achieve this end. More specifically, drawing from research (Baran et al., 2017; Maloney et al., 2019), ITE programs should project research evidence to pedagogy-related classes, examine a range of fit-for-purpose and meaningful innovative and inclusive pedagogies, offer time and spaces for students to reflect on these and enact their pedagogy in classroom settings.

Concluding Thoughts

As a globally concerned issue, teacher quality has been evolving with many human-driven needs. The main attention here is to grant the best teaching and learning practices in different contexts. Efforts in carrying out studies and enforcing policies are meant to improve teachers to be professionally competent in their subject field as well as in their teacher identity. Though previous endeavours intended to meet more nationwide needs and trends, present perspectives on education seek more international collaborations and comparisons to serve more equal opportunities for all and map some effective trajectories for improvement. Inspired by the globally agreed issues as humane qualities, digitalization, open-ended professional development, and research-based evidence, this study presents an international comparison to illustrate two different approaches in developing a roadmap for ITE programs.

Wishing to welcome much more indicators that can be infused into ITE programs to be able to act in accordance with research suggestions, we narrowed down our motives to enrich views on teacher quality. Core values and dimensions are regarded as both initial insights for the teaching profession and continuing qualities to connect with exemplified global issues. Digital transformation, as an inevitable topic in every field of human life, is iterated to remind the fundamental necessity to adapt prospective teachers with advanced digital competencies. Teacher agency, as a concept that has attracted increasing attention in the last few years, is included to highlight teacher professionalism and the importance of nurturing supportive environments to catch teacher educators' and policy makers' attention in rethinking ITE programs for future directions. Finally, we briefly glance at innovative and inclusive pedagogies referring to recent global changes.

To conclude, in this paper, we focus on the ITE documents in Scotland and Turkey to examine the promoted professional competencies and offer a framework to be utilized as a discussion point for ITE curricula developments. However, we are aware that there might be discrepancies between what these documents indicate and what actually happens in ITE curricula in the two contexts. Thus, future research could focus on how these standards and policies are enacted in Higher Education contexts, perhaps through qualitative research with teacher educators. Second, because establishing global roadmaps for ITE has attracted increased attention, this research calls for large-scale

comparative research in different countries. In saying that, we are cognizant of the cultural and social differences amongst countries. Nevertheless, international collaborative research has a strong potential to offer evidence and a rich picture to inform initial teacher education. This is especially imperative considering the global challenges all nations face.

Acknowledgements

Bilge Aslan Altan examined and reported the Turkish documents and finalized the whole manuscript (60%). Sinem Hizli Alkan examined and reported the Scottish documents reported (40%).

Conflicts of Interest

Authors declare that there is no conflict of interest.

Author Bios

Bilge Aslan Altan is a lecturer and research assistant working in curriculum and instruction department in Faculty of Education. She is interested in curriculum studies, digitally-enhanced teaching activities, and school-based practices.

Sinem Hizli Alkan currently works as a senior lecturer in the School of Education and Social Care at Anglia Ruskin University. Her research interests include curriculum studies, teacher agency, reflexivity, networks, and mathematics teaching/learning.

References

Alibrahim, F. A. (2020). Online teaching skills and competencies. *The Turkish Online Journal of Educational Technology (TOJET), 19*(1), 9–20. Retrieved from https://files.eric.ed.gov/fulltext/EJ1239983.pdf

Allen, A., Hancock, S. D., Lewis, C. W., & Starker-Glass, T. V. (2017). Mapping culturally relevant pedagogy into teacher education programs: A critical framework. *Teachers College Record, 119*(1), 1–26. https://doi/pdf/10.1177/016146811711900107

Aslan, A., & Chang, Z. (2017). Investigating variables predicting Turkish pre-service teachers' integration of ICT into teaching practices. *British Journal of Educational Technology, 48*(2), 552–570. https://doi.org/10.1111/bjet.12437

Baker-Doyle, K. (2019). "We want transformation, not reformation": Re-centering teacher education on equity and racial justice – Special issue introduction. *Review of Education, Pedagogy, And Cultural Studies, 41*(4-5), 211–217. https://doi.org/10.1080/10714413.2019.1698921

Balyer, A., & Öz, Ö. (2018). Academicians' views on digital transformation in education. *International Online Journal of Education and Teaching (IOJET), 5*(4), 809–830. Retrieved from http://iojet.org/index.php/IOJET/article/view/441/295

Baran, E., Canbazoglu Bilici, S., Albayrak Sari, A., & Tondeur, J. (2017). Investigating the impact of teacher education strategies on preservice teachers' TPACK. *British Journal of Educational Technology, 5*0(1), 357–370. https://doi.org/10.1111/bjet.12565

Benavides, L. M. C., Arias, J. A. T., Serna, M. D. A, Bedoya, J. W. B., & Burgos, D. (2020). Digital transformation in higher education institutions: A systematic literature review. *Sensors, 20*(11), 3291–3313. https://doi.org/10.3390/s20113291

Bereday, G. (1964). *Comparative method in education*. New York: Holt, Rinehart & Winston Inc.

Berkovich, I., & Benoliel, P. (2020). Marketing teacher quality: critical discourse analysis of OECD documents on effective teaching and TALIS. *Critical Studies in Education, 61*(4), 496–511. https://doi.org/10.1080/17508487.2018.1521338

Birch, P., Balcon, M. P., Bourgeois, A., Davydovskaia, O., & Tremosa, S. P. (2018). Teaching careers in Europe: Access, progression, and support. *Eurydice Report. Brussels: Education, Audiovisual and Culture Executive Agency, European Commission.*

Borthwick, A. C., & Hansen, R. (2017). Digital literacy in teacher education: are teacher educators competent? *Journal of Digital Learning in Teacher Education, 33*(2), 46–48. https://doi.org/10.1080/21532974.2017.1291249

Boylan, M., & Woolsey, I. (2015). Teacher education for social justice: Mapping identity spaces. *Teaching and Teacher Education, 46*, 62–71. https://doi.org/10.1016/j.tate.2014.10.007

Bozkurt, F. (2020). *21. yüzyıl becerileri açısından sosyal bilgiler öğretmenliği lisans programının değerlendirilmesi* [Evaluation of social studies teacher training program in terms of 21st century skills]. *Pamukkale University Journal of Education, 51*, 1–30. https://doi.org/10.9779/pauefd.688622

Canales, A., & Maldonado, L. (2018). Teacher quality and student achievement in Chile: Linking teachers' contribution and observable characteristics. *International Journal of Educational Development, 60*, 33–50. https://doi.org/10.1016/j.ijedudev.2017.09.009

Cochran-Smith, M. (2021). Exploring teacher quality: International perspectives. *European Journal of Teacher Education, 44*(3), 415–428. https://doi.org/10.1080/02619768.2021.1915276

Darling-Hammond, L. (2021). Defining teaching quality around the world. *European Journal of Teacher Education, 44*(3), 295–308. https://doi.org/10.1080/02619768.2021.1919080

Darling-Hammond, L. (2020). Accountability in teacher education. *Action in Teacher Education, 42*(1), 60–71. https://doi.org/10.1080/01626620.2019.1704464

Darling-Hammond, L. (2006). Constructing 21st-century teacher education. *Journal of Teacher Education, 57* (3), 300–314. https://doi.org/10.1177/0022487105285962

Estellés, M., & Fischman, G. E. (2021). Who needs global citizenship education? A review of the literature on teacher education. *Journal of Teacher Education, 72*(2), 223–236. https://doi.org/10.1177/0022487120920254

Falloon, G. (2020). From digital literacy to digital competence: the teacher digital competency (TDC) framework. *Education Technology, Research and Development, 68*, 2449–2472. https://doi.org/10.1007/s11423-020-09767-4

Flores, M. A. (2020). Feeling like a student but thinking like a teacher: a study of the development of professional identity in initial teacher education. *Journal of*

Education for Teaching, *46*(2), 145–158. https://doi.org/10.1080/02607476.2020.1724659

Flores, M. A., & Niklasson, L. (2014). Why do student teachers enrol for a teaching degree? A study of teacher recruitment in Portugal and Sweden. *Journal of Education for Teaching*, *40*(4), 328–343. https://doi.org/10.1080/02607476.2014.929883

Foulger, Teresa & Graziano, Kevin & Schmidt-Crawford, Denise & Slykhuis, David & Chang, Yeng & Christensen, Rhonda & Dillon, Deborah & Heath, Marie & Knezek, Gerald & Krutka, Daniel & Parrish, Andrea & Sadera, William & Thomas, Amanda. (2020). Fostering new research following the teacher educator technology competencies (TETCs): Research from the JTATE special issue, preparing all teacher educators to support teacher candidates' integration of technology. In *Society for Information Technology & Teacher Education International Conference* (pp. 436–443). Association for the Advancement of Computing in Education (AACE), Waynesville, NC, USA.

General Teaching Council for Scotland. (2021a). *The Standard for Full Registration*. https://www.gtcs.org.uk/web/FILES/Professional-Standards/Standard-for-Full-Registration.pdf

General Teaching Council for Scotland. (2021b). *Learning for Sustainability: A Professional Guide for Teachers*. https://www.gtcs.org.uk/wp-content/uploads/2021/09/professional-guide-learning-for-sustainabilty.pdf

Giroux, H. (2008). Education and the crisis of youth: schooling and the promise of democracy. *The Educational Forum*, *73*(1), 8–18. https://doi.org/10.1080/00131720802539523

Goddard, J. T. (2005). Toward Glocality: Facilitating Leadership in an Age of Diversity. *Journal of School Leadership*, *15*(2), 159–177. https://doi.org/10.1177/105268460501500204

Goodwin, A. L. (2020). Globalization, global mindsets and teacher education. *Action in Teacher Education*, *42*(1), 6–18. https://doi.org/10.1080/01626620.2019.1700848

Guarino, C. M., Santibanez, L., & Daley, G. A. (2006). Teacher recruitment and retention: A review of the recent empirical literature. *Review of Educational Research*, *76*(2), 173–208. https://doi.org/10.3102/00346543076002173

Gudmundsdottir, G. B., & Hatlevik, O. E. (2018). Newly qualified teachers' professional digital competence: implications for teacher education. *European Journal of Teacher Education*, *41*(2), 214–231. https://doi.org/10.1080/02619768.2017.1416085

Guerriero, S. (Ed.) (2017), *Pedagogical Knowledge and the Changing Nature of the Teaching Profession.* Educational Research and Innovation, OECD Publishing, Paris, https://doi.org/10.1787/9789264270695-en

Guðjónsdóttir, H., & Óskarsdóttir, E. (2020). 'Dealing with diversity': debating the focus of teacher education for inclusion. *European Journal of Teacher Education*, *43*(1), 95–109. https://doi.org/10.1080/02619768.2019.1695774

Gülmez, G. (2019). *Factors behind teacher agency: A structural equation modelling study* [Doctoral thesis, Middle East Technical University].

Harris, D. N., & Sass, T. R. (2011). Teacher training, teacher quality and student achievement. *Journal of Public Economics, 95*(7-8), 798–812. https://doi.org/10.1016/j.jpubeco.2010.11.009

Hicks, S. D. (2011). Technology in today's classroom: Are you a tech-savvy teacher? The Clearing House. *A Journal of Educational Strategies, Issues and Ideas, 84*(5), 188–191. https://doi.org/10.1080/00098655.2011.557406

Hizli-Alkan, S. (2021). Curriculum making as relational practice: A qualitative ego-network approach. *The Curriculum Journal, 32*, 421–443. https://doi.org/10.1002/curj.98

Hizli-Alkan, S. (2022). Traversing between Supra, Macro, and Meso Sites. *Scottish Educational Review, 54*(1), 70–92. https://doi.org/10.1163/27730840-54010007

Intesfjord, E. J., & Munthe, E. (2018). Educating digitally competent teachers: A study of integration of professional digital competence in teacher education. *Teaching and Teacher Education, 67*, 37–45. https://doi.org/10.1016/j.tate.2017.05.016

ISTE. (2017). *ISTE standards for educators: A guide for teachers and other professionals.* Retrieved from https://www.iste.org/standards/iste-standards-for-teachers

König, J., Jäger-Biela, D. J., & Glutsch, N. (2020). Adapting to online teaching during COVID-19 school closure: Teacher education and teacher competence effects among early career teachers in Germany. *European Journal of Teacher Education, 43*(4), 608-622. doi:10.1080/02619768.2020.1809650

Lynch, M. (2020). E-learning during a global pandemic. *Asian Journal of Distance Education, 15*(1), 189–195. Retrieved from https://files.eric.ed.gov/fulltext/EJ1290016.pdf

Maloney, T., Hayes, N., Crawford-Garrett, K., & Sassi, K. (2019). Preparing and supporting teachers for equity and racial justice: Creating culturally relevant, collective, intergenerational, co-created spaces. *Review of Education, Pedagogy, And Cultural Studies, 41*(4-5), 252–281. https://doi.org/10.1080/10714413.2019.1688558

Menter, I., & Flores, M. A. (2020). Teacher education, teacher professionalism and research: international trends, future directions. *European Journal of Teacher Education, 44*(1), 1–4. https://doi.org/10.1080/02619768.2020.1850550

MoNE. (2017a). *Öğretmenlik mesleği genel yeterlikleri* [General competencies for teaching profession]. Retrieved from http://oygm.meb.gov.tr/meb_iys_dosyalar/2018_06/29111119_TeachersGeneralCompetencies.pdf

MoNE. (2017b). *Öğretmen strateji belgesi* [Strategy report of teachers]. Retrieved from http://oygm.meb.gov.tr/meb_iys_dosyalar/2017_07/26174415_Strateji_Belgesi_RG-Ylan-_26.07.2017.pdf

MoNE. (2017c). *Suriyeli çocuklarin Türk eğitim sistemine entegrasyonunun desteklenmesi projesi* [Supporting Syrian children to be integrated into Turkish education system project]. Retrieved from https://hamitsutmenio.meb.k12.tr/meb_iys_dosyalar/34/31/738053/dosyalar/2018_01/25224048_PYCTES_DesteklemeEgitimKlavuzu.pdf

Noah, M., & Jennifer, A. J. (2013). Methodological issues in comparative education studies: An exploration of the approaches of Kandel and Holmes. *Journal of Educational Review, 6*(3), 349–356. Retrieved from http://oro.open.ac.uk/83844/

OECD. (2018). *The future of education and skills: Education 2030.* Retrieved from https://www.oecd.org/education/2030/E2030 Position Paper (05.04.2018).pdf

OECD. (2019). *A flying start: Improving initial teacher preparation systems*. Paris: OECD Publishing. https://doi.org/10.1787/cf74e549-en

Olsen, B. (2021). Teacher quality around the world: what's currently happening and how can the present inform the future? *European Journal of Teacher Education, 44*(3), 293–294. https://doi.org/10.1080/02619768.2021.1917053

Phillips, D. (2006). Comparative education: Method. *Research in Comparative and International Education, 1*(4), 304–319. https://doi.org/10.2304/rcie.2006.1.4.304

Philpott, C. (2014). A pedagogy for initial teacher education in England. *Teacher Education Advancement Network Journal, 6*(3), 4–16.

Pietarinen, J., Pyhältö, K., & Soini, T. (2019). Shared sense-making in curriculum reform: Orchestrating the local curriculum work. *Scandinavian Journal of Educational Research, 63*(4), 491–505. https://doi.org/10.1080/00313831.2017.1402367

Priestley, M., Biesta, G. J. J., & Robinson, S. (2015). *Teacher agency: An ecological approach.* London: Bloomsbury Academic.

Pushpanadham, K. (2020). *Teacher education in the global era*. Singapore: Springer.

Scottish Government. (2016). *Enhancing learning and teaching through the use of digital technology*. https://www.gov.scot/publications/enhancing-learning-teaching-through-use-digital-technology/documents/

Sinnema, C., & Aitken, G. (2013). Emerging international trends in curriculum. In M. Priestley & G. J. J. Biesta (Eds.), *Reinventing the curriculum: New trends in curriculum policy and practice*. London: Bloomsburry Academic.

Sivesind, K., Bachmann, K., & Afsar, A. (2013). Researching curriculum specification and freedom in Norway. In W. Kuiper & J. Berkvens (Eds.), *Balancing curriculum regulation and freedom across Europe, CIDREE yearbook 2013* (pp. 163–189). Enschede, the Netherlands: SLO.

Snoek, M. (2021). Educating quality teachers: how teacher quality is understood in the Netherlands and its implications for teacher education. *European Journal of Teacher Education, 44*(3). 309–327. https://doi.org/10.1080/02619768.2021.1931111

Sr.-Clarke, G., & Zagarell, J. (2012). Technology in the classroom: Teachers and technology: a technological divide. *Childhood Education, 88*(2), 136–139. https://doi.org/10.1080/00094056.2012.662140

Symeonidou, S. (2017). Initial teacher education for inclusion: A review of the literature. *Disability & Society, 32*(3), 401–422. https://doi.org/10.1080/09687599.2017.1298992

Tatto, M. (2021). Professionalism in teaching and the role of teacher education. *European Journal of Teacher Education, 44*(1), 20–44. https://doi.org/0.1080/02619768.2020.1849130

Tican, C., & Deniz, S. (2019). Pre-service teachers' opinions about the use of 21st century learner and 21st century teacher skills. *European Journal of Educational Research, 8*(1), 181–197. https://doi.org/10.12973/eu-jer.8.1.181

Walshe, N., & Tait, V. (2019). Making connections: a conference approach to developing transformative environmental and sustainability education within initial teacher education. *Environmental Education Research, 25*(12), 1731–1750. https://doi.org/10.1080/13504622.2019.1677858

Watkins, A., & Donnelly, V. (2014). Core values as the basis for teacher education for inclusion. *Global Education Review, 1*(1), 76–92. Retrieved from https://ger.mercy.edu/index.php/ger/article/view/9

YÖK, [HEC]. (2018). *Öğretmen yetiştirme lisans programları* [Initial teacher education curricula]. Retrieved from https://www.yok.gov.tr/kurumsal/idari-birimler/egitim-ogretim-dairesi/yeni-ogretmen-yetistirme-lisans-programlari

Zhao, Y. (2010). Preparing globally competent teachers: A new imperative for teacher education. *Journal of Teacher Education, 61*(5), 422-431.

Journal of Theoretical Educational Science, 16(3), 502-535, July 2023
Kuramsal Eğitimbilim Dergisi, 16(3), 502-535, Temmuz 2023
[Online]: http://dergipark.org.tr/akukeg
DOI number: http://doi.org/10.30831/akukeg.1254380

Improving the Teacher Training Process in Special Education: An Action Research*

Özel Eğitim Alanında Öğretmen Yetiştirme Sürecinin Geliştirilmesi: Bir Eylem Araştırması

Yunus YILMAZ** **Hasan GÜRGÜR*****

Received: 21 February 2023 **Research Article** **Accepted:** 19 April 2023

ABSTRACT: The special education teaching program in Turkey was united under a single roof with the decision taken by the Council of Higher Education in 2016. With this decision, the programs for teachers of the hearing impaired, the mentally disabled, the visually impaired and the gifted/special talented were organized as a new and single undergraduate program under the name of "Special Education Teaching". This research aimed to enhance the teaching practice process within the new special education program. For this purpose, the study was designed as action research. The research was conducted in a special education department in a province with a medium-sized population in Central Anatolia. The research participants included 19 faculty members, 24 undergraduate students, 12 special education teachers, one Ministry of National Education official, and one Directorate of National Education official. Semi-structured interviews, participant information forms, video recordings, documents, and a researcher diary were used for data collection. The data obtained from the research were analyzed using a systematic analysis approach. As a result of the research, arrangements were made in the new special education teacher training program in the areas needed in the teacher training process. Steps such as reorganizing the evaluation criteria and creating guidelines to determine the responsibilities of stakeholders are among these arrangements. With the Covid-19 pandemic, activities were carried out for material design and use in distance education and transfer of theoretical knowledge to the online teaching practice environment.

Keywords: Special education, teaching practice, teacher training, pandemic, distance education.

ÖZ: Özel eğitim öğretmenliği programı Yüksek Öğretim Kurulu Başkanlığı'nın 2016 yılında aldığı kararla tek çatı altında birleştirilmiştir. Bu karar ile birlikte işitme engelliler, zihin engelliler, görme engelliler ve üstün zekâlılar/özel yetenekliler öğretmenliği programları, "Özel Eğitim Öğretmenliği" adı altında yeni ve tek bir lisans programı olarak düzenlenmiştir. Araştırma kapsamında yeni özel eğitim öğretmenliği programında öğretmenlik uygulaması sürecinin geliştirilmesi amaçlanmıştır. Bu amaçla çalışma, eylem araştırması olarak desenlenmiştir. Araştırma İç Anadolu bölgesinde orta ölçekte nüfusa sahip bir ildeki özel eğitim bölümünde gerçekleştirilmiştir. Araştırma katılımcıları arasında 19 öğretim üyesi, 24 lisans öğrencisi, 12 özel eğitim öğretmeni, bir MEB yetkilisi ve bir MEM yetkilisi yer almaktadır. Araştırma kapsamında veri toplamada yarı-yapılandırılmış görüşme, katılımcı bilgi formu, video kayıtları, dokümanlar ve araştırmacı günlüğü kullanılmıştır. Araştırmadan elde edilen veriler sistematik analiz yaklaşımı ile analiz edilmiştir. Araştırma sonucunda yeni özel eğitim öğretmenliği programında öğretmen yetiştirme sürecine ilişkin gereksinim duyulan alanlarda düzenlemeler yapılmıştır. Değerlendirme kriterlerinin yeniden düzenlenmesi, paydaşların sorumluluklarının belirlenmesi adına yönergelerin oluşturulması gibi adımlar bu düzenlemeler arasında yer almaktadır. Covid-19 Pandemisiyle birlikte uzaktan eğitimde materyal tasarımı ve kullanımı, teorik bilgilerin çevrimiçi öğretmenlik uygulama ortamına transferine yönelik faaliyetler yürütülmüştür.

Anahtar kelimeler: Özel eğitim, öğretmenlik uygulaması, öğretmen yetiştirme, pandemi, uzaktan eğitim.

* This study titled "Development of Teaching Practice in Special Education: Anadolu University Example" is derived from his doctoral dissertation.

** *Corresponding Author*: Res. Asst. Dr., Anadolu University, Eskişehir, Türkiye, yunus_yilmaz@anadolu.edu.tr, https://orcid.org/0000-0001-6988-798X

*** Prof. Dr., Anadolu University, Eskişehir, Türkiye, hasangurgur@anadolu.edu.tr, https://orcid.org/0000-0002-4016-4048

Citation Information

Yılmaz, Y., & Gürgür H. (2023). Improving the teacher training process in special education: An action research. *Kuramsal Eğitimbilim Dergisi [Journal of Theoretical Educational Science]*, 16(3), 502-535.

ISSN: 1308-1659

Two main practices are utilized worldwide to ensure the qualitative development of pre-service teachers or teachers actively practicing their profession. The first of these is the pre-service program implemented for pre-service teachers, while the other is in-service training (Işık et al., 2010). In-service training refers to the process of providing scientifically proven knowledge and skills that teachers are lacking (Budak & Demirel, 2003). The pre-service teacher training process is the practice carried out through undergraduate programs using training models or approaches determined by the relevant institutions (Abazaoğlu et al., 2014). The teacher training process in the pre-service system is comprehensive and multidimensional. It includes steps such as monitoring and evaluating the whole process from theoretical training to teaching practice (Kavcar, 2002).

Teaching practice, which can be considered the last step of pre-service education, is the process in which final undergraduate students study for a certain period of time in a class appropriate to their field of specialization. In this learning process, an experienced teacher and/or faculty member takes on the role of a guide (Eurydice, 2018; Van Schagen Johnson et al., 2017). According to Darling-Hammond (2006), the most fundamental step of the teacher training process is teaching practice. Teaching practice involves applying the theoretical knowledge gained during undergraduate education to a real-life teaching environment. It is essentially the process of preparing for and gaining experience in teaching, culminating in actual teaching experience (Paker, 2008; Yücesoy Özkan et al., 2019). Developing evaluation skills involves self-inquiry, identifying gaps in knowledge and skills, becoming aware of one's own teacher identity, and developing reflective thinking skills through participation in a teaching practice course (Collier, 1999; Freese, 1999; McDuffie, 2004; Poulou, 2007).

As of 2014, the Ministry of National Education changed the principles of teacher assignment. The programs of teaching the mentally handicapped, teaching the hearing impaired, teaching the visually handicapped, and teaching the gifted were merged as special education teaching (Presidency of the Board of Education, 2014). Teacher appointments began to be made with a holistic view, considering candidates as potential special education teachers regardless of their academic background. In parallel with this development, the Council of Higher Education made a similar arrangement in 2016. In the two years until this date, graduations as teachers of the mentally disabled, teachers of the hearing impaired, teachers of the visually impaired, and teachers of the gifted and talented continued at universities. However, as of the 2016-2017 academic year, these fields were combined into a new and single undergraduate program under the title of "special education teaching" (CHE, 2016). With the new regulation, autism spectrum disorder and learning disability education were added to the special education department, which covers four different departments. Within the scope of the special education teaching program, a new course catalog was created with content from all departments. In addition to the basic courses related to special education, there are also courses related to the minor/subfields that undergraduate students can specialize in. Basic courses in special education are compulsory, and courses related to specialization in minor/subspecialty areas are elective. With this arrangement made by CHE, it is aimed at students who will graduate as special education teachers to specialize in one or more minors/subfields (CHE, 2016).

In the 2019/2020 academic year, the teaching practice course of the new special education teaching program started to be held for the first time. In our country, the teaching practice course is carried out in all faculties in cooperation with the Ministry of National Education and CHE. This cooperation process is carried out through the Ministry of National Education Information Systems (MEBBIS) in order to monitor and control the teaching practice. The system, which operates under the control of MNE, includes many modules. One is the Practicum Student Evaluation (UOD) module (MNE, 2021). Teachers and faculty members have access to the UOD module. In this module, grade scoring and course evaluations of undergraduate students who take teaching practice courses in their final year are made. After the practices carried out by the undergraduate student, teachers and academics regularly write their evaluations on the module, including their comments, and score them. Although there are many problems with the teaching practice course in the new program, the pandemic process has started. After the first case of Coronavirus (Covid-19) emerged in Wuhan, China, on December 1, 2019, the World Health Organization (WHO) declared a pandemic on March 11, 2020. The Covid-19 pandemic has made changes in health, the economy, social life, and educational practices inevitable on a global scale (Can, 2020). With this global pandemic, educational institutions have started distance education practices (CHE, 2020). The Education Information Network has pioneered the applications realized in our country. In addition, distance education was continued through TRT EBA TV, EBA Portal, live classroom applications, and other reliable open-source platforms (MNE, 2020). On the other hand, programs such as Ariel, Moodle, UNIBO, and Zoom are the platforms used by the world in distance education (Dikmen & Bahçeci, 2020). Therefore, the pandemic has directly affected special education teaching practice courses.

In summary, the unification of special education under a single roof has made it necessary to develop a new plan for teaching practice. With the Covid-19 pandemic, the research process has gained a new dimension. From this point of view, the study aims to improve the teaching practice process in the new special education teaching undergraduate program. Within the scope of the research, stakeholder views on the new special education program and the planning and implementation process of the teaching practice course were focused on. In addition, the effects of the Covid-19 pandemic on the teaching practice course and the teaching practice process carried out through distance education were evaluated.

Method

In order to examine and improve the teacher training process in the new special education teaching undergraduate program, the study was designed as action research. Action research is the study of a real classroom or school situation to understand and improve the quality of the teaching process (Johnson, 2019; Schmuck, 1997). It consists of the steps of identifying a problem, finding a solution to this problem, and implementing and evaluating the solutions found (Borgia & Schuller, 1996). Action research can help teachers examine their own practices or an existing problem, support teachers' professional development, and help develop programs that meet the needs of students (Dinkelman, 1997; Glesne, 2013; Johnson, 2005).

Participants

The participants of the study consisted of stakeholders involved in the teaching practice process in special education. These participants are given in Table 1.

Table 1

Participants

Participants	Number of People
Teaching practice directive preparation team members	11
Faculty members from other universities with special education departments	3
Faculty members conducting the teaching practice course in the special education department	5
Teachers in whose class teaching practice is carried out	12
MEBBİS and PSE officials working in MNE and DNE	2
Undergraduate students taking teaching practice course	24
Special education teaching practice course development commission members	5
Validity committee members	5
Thesis monitoring commission members	3

*MNE: Ministry of National Education, *DNE: Directorate of National Education, *MEBBİS: Ministry of National Education Information Systems, *PSE: Teacher Practice Evaluation System

The researcher, teaching practice directive preparation team, and special education teaching practice course development commission members in Table 1 carried out interventions to improve the process in light of the data obtained. Undergraduate students taking the teaching practicum course, faculty members conducting the teaching practicum course in other universities with special education departments, teachers conducting the teaching practicum course in their classrooms, administrators conducting the teaching practicum course in their schools, faculty members conducting the teaching practicum course in the special education department, and ministry and national education directorate officials responsible for the functioning of the MEBBIS system. The members of the thesis monitoring committee, who also served on the validity committee, were responsible for providing theoretical and methodological oversight of the interventions aimed at improving the process. In the following sections of the report, codes are used to convey information about the participants. First, the occupation was indicated, and then the number was given. Implementation Coordinator 1, Teacher 1, Teacher 2.

Research Environment

Since the research covers data collection and action plans for the special education teaching program in general, many environments were involved in the process. In addition, while face-to-face environments were used before the pandemic, the research continued on online platforms after the pandemic. Before the pandemic, the pre-pandemic research was generally conducted at the faculty of education, where the special education department is located in a province with a medium-sized population in

the Central Anatolia region. The office of the special education department head and undergraduate and graduate classes at the faculty were frequently used for planning and evaluation meetings. After the pandemic, online platforms such as Zoom, Jitsi Meet, and EBA were the environments where the study was conducted.

Data Collection

During the research process, many data collection techniques were utilized in order to ensure data diversity, increase the quality of the research, and reflect a detailed and holistic view (Creswell, 2014; Johnson, 2019; Mills, 2003). This data collection includes demographic information form, interviews, document analysis, researcher diary, field notes, and meeting minutes. Information on the data collection and data source used is given in Table 2.

Table 2

Information on the Data Collection and Data Source

Demographic Information Form	Interviews	Video Recording	Document Review	Field notes	Meeting Minutes
All participants	Teacher practice coordinator Teachers Undergraduate students MEBBIS officials Faculty members of other universities	Implementation Guide Preparation Team Validity committee Undergraduate student lecture shoots	Documents and documents of undergraduate students Documents related to teaching practice Evidence of the research implementation process	Researcher diary Researcher experiences and observations Unrecorded opinions of the participants	Implementation guide drafting team Implementation quality improvement commission Validity committees

Within the scope of the research, 15 individual semi-structured interviews were conducted. Five group interviews were conducted. Three video recordings were made with the implementation guide preparation team before the pandemic. After the pandemic, 18 video recordings were made, including informative seminars and lectures to undergraduate students. Nine validity committee meetings were also videotaped. Plans, materials, and transcripts of all undergraduate students participating in the study were backed up as documents. In addition, the minutes of the validity committee, special education teaching quality enhancement commission, and the end-of-semester meeting minutes of the practicum coordinators were also included among the documents. With the subject determination phase of the research, regular writing started on 10.06.2019. During the writing process, which continued until 08.01.2021, the last implementation, a total of 35 pages and 74 headings were kept in the diary. Information about the interviews and videos recorded within the scope of the research is given in

Table 3

Recorded Interviews and Videos

Data type	Number	Date	Duration (min./sec.)	Location
Semi-structured interviews	15	04.07.2019 08.01.2020	13:04 65:10	Participants' offices Teachers' room Telephone
Focus group interviews	5	11.11.2019 19.05.2020	19:12 24:52	Teachers' room Jitsi Meet
Lesson shots	18	23.05.2020 08.01.2021	28:55 118:10	Zoom EBA
Validity committees	9	01.07.2019 10.01.2021	32:40 66:36	Head of department Office Zoom
Guideline preparation meetings	3	24.07.2019 06.08.2019	34:21 59:45	Graduate course classes
Other meetings	5	24.12.2019 18.11.2021	21:01 72:10	Graduate course classes Lecture hall Zoom

*EBA: National education information network

As seen in Table 3, semi-structured interviews were conducted between 04.07.2019 and 08.01.2020. The shortest interview lasted 13 minutes and 04 seconds, while the longest interview lasted 65 minutes and 10 seconds. Group interviews were conducted between 11.11.2019 and 19.05.2020, with the shortest lasting 19 minutes and 12 seconds and the longest lasting 24 minutes and 52 seconds. After the pandemic, lectures with the participation of undergraduate students were filmed entirely through online platforms. The shortest lecture lasted 28 minutes and 55 seconds, while the longest was held in two sessions as an information seminar and lasted 118 minutes and 10 seconds. The validity committees were generally recorded in the office of the department head. The first one was held on 01.07.2019, and the last one was held on 10.01.2021. Three meetings were held in graduate education classes on 24.07.2019 and 06.08.2019 for the process of preparing the guidelines, stakeholder tasks, and evaluation forms for the teaching practice course. Other meetings included the end-of-semester meeting of the practicum instructors, the commission for improving the quality of the teaching practice course, and the thesis monitoring committees. The shortest of these meetings lasted 34 minutes 21 seconds, and the longest 59 minutes 45 seconds. While graduate classrooms and lecture halls were used for the meetings before the pandemic, the Zoom platform was used after the pandemic.

Data Analysis

The data collected within the scope of the research were analyzed with a systematic analytical approach. The fact that the action research cycle is constantly open

to change and the planning and realization of actions as a result of this change necessitates a systematic analytical analysis approach (Altrichter et al., 2005). The systematic analysis process consists of sequential steps such as data collection, data analysis and selection, transformation of data into findings, and interpretation of findings. Since action research is flexible and allows for change, new findings from the data analysis and selection step can be included in the report if needed (Huberman & Miles, 2002).

Within the scope of the research, the steps of determining the current situation, monitoring, and evaluation were reported through "Word Cloud" analysis. Word Cloud Analysis was conducted through the NVIVO 11 program. Word Cloud was used to support the data obtained as a result of semi-structured interviews and to concretize the emphases and trends in the views conveyed by the participants (Heimerl et al., 2014).

Validity and Reliability-Convincingness of the Data

In the environment in which qualitative research is conducted, the danger of bias may arise if the researcher is a member or employee of the organization (Hesse-Biber & Leavy, 2011). The elimination of bias and objective reflection is possible through measures to ensure research validity. In order to ensure the validity, reliability, or trustworthiness of the research, data diversity was used. The sources from which data were collected included video recordings, audio recordings, documents, research diary, meeting minutes, and products that emerged during the process. Data triangulation was used to check and verify the research in many aspects (Creswell, 2005; Yıldırım & Şimşek, 2011; Yin, 2011). The data were collected for a long period of time and in detail so that they could be analyzed in depth and described in detail. Emphasis was placed on ensuring that the data provided a coherent integration with each other and were reported in detail by linking them with the research in the literature (Denzin & Giardina, 2011). Expert opinions were consulted in the validity meetings held throughout the research process. The validity committee controlled all steps of the research process defined the role of the researcher and approved compliance with the research model (Bogdan & Biklen, 2007). In addition, thesis monitoring committee meetings were held twice a year, and arrangements were made in line with the suggestions of field experts.

Research Ethics

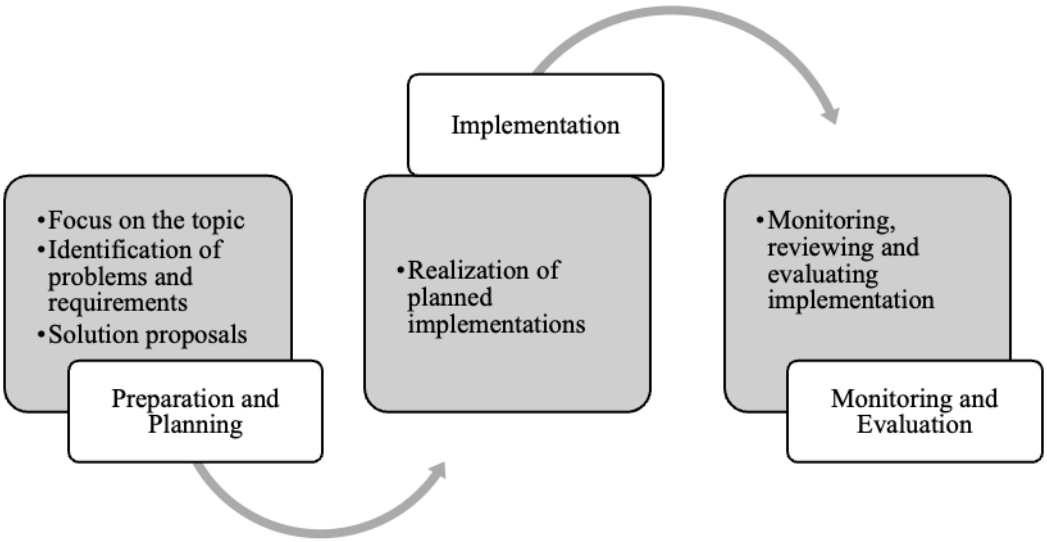
Ethics committee permission number 86289 was obtained from the relevant university's scientific research and ethics committee where the research was conducted. All steps of the study and the use of the data obtained were explained to the participants in detail in the informed consent form. Participant permissions were obtained verbally and in writing. While determining the participants, care was taken to ensure that they were volunteers. In addition, participants were informed that they could withdraw from the study at any time (Bogdan & Biklen, 2007). In order to prevent the principle of bias, the data collected throughout the research were transcribed verbatim as the participants reported them without any changes (Gay & Airasian, 2003). In order to realize the principle of confidentiality as stated in the informed consent form, participants were assigned code names in the form of a profession-number. In line with the principle of responsibility, action plans, and practices were carried out

systematically. Practices were also carried out in line with the needs of all final-year undergraduate students other than the research participants. In line with the principle of transparency and honesty, all possible data were collected through audio or video recording (Denzin & Giardina, 2011; Huberman & Miles, 2002).

Findings

The study aimed to improve the teacher training process in the special education teacher training program, was carried out in three main stages. These stages, which emerged after the analysis of the data obtained, are (a) preparation and planning, (b) implementation, and (c) monitoring and evaluation. Figure 1 shows the research process cycle formed by the three basic stages.

Figure 1
General Cycle of the Research Process



As seen in Figure 1, the research process consists of three basic stages in a spiral manner. At each stage of the process, cycles emerged within themselves. The validity committee played an active role in the entire research process, from preparation to evaluation. The findings section will be presented by detailing the four main stages and the cycles within them. Therefore, in the following section, the findings obtained from the analysis of the collected data will be reported according to the order in which the stages took place.

Phase One: Preparation and Planning (10.06.2019-25.10.2020)

The research process first started with the preparation phase. At this stage, one-to-one interviews were frequently conducted between the researcher and the thesis advisor. In line with the decisions taken together with the thesis advisor, the preparation phase consisted of five steps (Researcher Diary, 17.06.2019). These steps are (a) focusing on the topic, (b) deciding on the setting in which the research will be conducted, (c) determining the research boundaries, (d) identifying stakeholders related to the topic, and (e) describing the current situation.

After the topic, location, participants, and boundaries were determined, preliminary interviews were conducted to describe the current situation (I. Validity

Committee Decisions, 01.07.2019). The questions related to the preliminary interviews are presented in Appendix 1. At this stage, the researchers sought answers to the following questions:

1. Is the special education department ready for teaching practice after the unification of the special education program at the undergraduate level?
2. How will the teaching practice course be conducted after the merger?
3. What are the problems related to the teaching practice process?
4. What are the solution suggestions of the practicum instructors regarding the problems?
5. Has the unification of the program created new requirements for the teaching practice course?
6. If so, what are these requirements, and how can they be met?

After the data collection process started, with the emergence of the Covid-19 Pandemic, similar questions were deepened to be valid for distance education. In line with these questions, preliminary interviews were conducted with stakeholders, and the current situation was described. After the analysis of the interviews, three themes were reached.

Opinions on the New Special Education Teacher Education Program

The first theme is the opinions on the new special education teaching undergraduate program. The first striking finding in the interviews was that the process of merging departments at the undergraduate level was not carried out systematically. Faculty Member 1 stated this as follows: "In my opinion, if the system had been put in place in a very appropriate way, which is not for me. I could say okay, but I always have this opinion. I think it happens in whichever field people feel competent before they make a choice when they take the university exam." It is seen that the participants have different attitudes towards the merging of special education subfields. Teacher 7 expressed her negative views on the merger as follows: "I do not find the merger of special education right because it is a four-year undergraduate degree. I mean, I think that the university students who are trained are better in special fields." Unlike the teachers, the faculty members generally have a positive view of the new special education program. There is a widespread view that this program is an inevitable step, despite its problems and shortcomings. As a matter of fact, Faculty Member 3 stated this situation as follows: "Will they be assigned to their own field regardless of which field they graduate in hearing, mind? No. It was obvious that it was going to merge, it was just a bit untimely and fast. It was already a single department years ago, and now it is again. We need to look at what to do next."

Problems Arising After the New Program

The problems brought by the new program are encountered as another theme. These problems include the incompatibility of the selected subfield and the classes in which the teaching practice will be carried out, the high number of students, the lack of communication between the faculty members conducting the teaching practice, and the differences between students with special needs encountered after undergraduate education. As an example of these problems, Faculty Member 2 said, "This will bring us the following problem: A friend of ours who chooses the hearing sub-field can also

choose the mind. But how will they do the teaching practice?". Faculty Member 3 "We had a lack of communication even when the fields were separate. Now it will become even more complicated". In addition, students trying to practice what they do not know, the short duration of the teaching practice course hours as well as the short duration of the practice periods, are seen among other problems. Teacher 8 said, "How can they practice in a field and become specialized?" and Teacher 11 said, "They are doing something they don't know, how are they doing it? I mean because he did not take the course". Lecturer 4 stated, "Practice hours are insufficient. Even in the past, we used to find them few, now they are even fewer", and Teacher 9 similarly stated, "The number of internship hours and the number of internships should be increased."

Requirements After the New Program

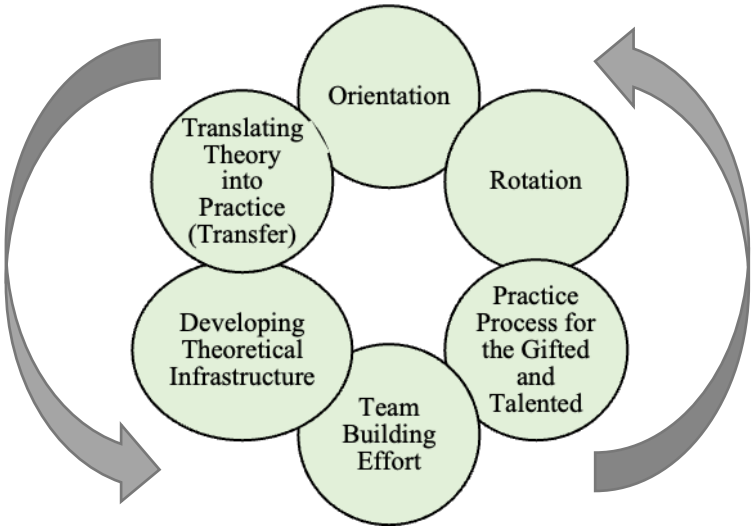
In connection with the problems listed, needs related to teaching practice also emerged. The most prominent of these needs were listed as the need for a common evaluation form due to the departmental merger, the need for a general list of directives to determine rules, responsibilities, and boundaries, and the opening of institutions and classrooms that provide education for the gifted for teaching practice. Faculty Member 5 stated the following regarding the needs: "We all need to come together and jointly review the evaluation forms that we have applied so far, which we have applied separately for hearing and separately for the mind." Faculty Member 1 stated that "There is chaos right now. No one knows what to do, where to start, and how to continue. There is a need for a new system and distribution of tasks." Faculty Member 2 stated that there is a need for BILSEM (Science and Art Education Center) for the teaching practicum course for students who choose the sub-field of giftedness: "The practice schools they can go to are very, very limited. There are BILSEMs, but they are not defined in MEBBIS program".

The findings in the word cloud overlap with the problems listed above. After the unification of special education at the undergraduate level, it was emphasized that the teaching practice system has become complex and that there is a need for objective evaluation criteria, teamwork, and cooperation. In addition, findings such as lack of communication, the high number of students and the low number of schools, and the lack of unification were found. Strengthening the theoretical background of undergraduate students and the need for teaching practice in BILSEMs for the gifted are also among the findings encountered in the word cloud.

Second Phase: Realization of Practices (06.07.2019-08.01.2021)

The data collected within the scope of the research were analyzed step by step, and six cycles were revealed with the analysis. The cycles reached within the scope of the research are given in Figure 2.

Figure 2
Cycles Realized in the Research



As can be seen in Figure 2, the research involved the orientation process, rotation, the functioning of the US implementation of gifted education, team-building efforts, the development of the theoretical infrastructure, and the transformation of theory into practice (transfer) cycles.

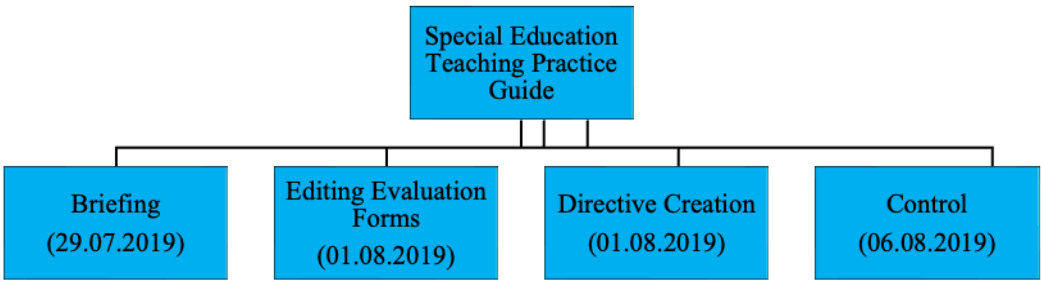
Orientation

Since the decision to implement the new program was made very close to the academic year, it was necessary to make quick decisions to solve the problems encountered. In this process, defined as orientation, preliminary interviews were conducted with faculty members, the data obtained from the interviews were analyzed, findings were reached, plans were made, and the plans were presented to the validity committee. It was decided to create a guideline for teaching practice in special education before the start of the academic year (I. Validity Committee Decision, 01.07.2019).

The need for a teaching practice guideline to be created before the start of the 2019-2020 academic year is understood from the participant statements. As a matter of fact, Lecturer 1 stated this need as "we all need to come together and jointly review the evaluation forms that we have applied so far, which we have applied separately for hearing and separately for the mind." Lecturer 2 stated that "common rules that everyone will follow are necessary." Within the framework of this guideline, two main stages can be mentioned: organizing the evaluation forms and creating instructions.

Figure 3

Application Guide Creation Steps



Three meetings were organized during the process of organizing the special education teaching practice guide, as shown in Figure 3. These meetings were held with 11 faculty members so that at least one faculty member from each sub-field in the special education department participated in these meetings. The content of the implementation guide included the creation of criteria for evaluating student practices and grading schemes in the sub-field of education of the mentally disabled (skills teaching, concept teaching, social skills teaching, behavior modification), evaluation criteria in the sub-fields of hearing, vision, and giftedness, and the duties and responsibilities of all stakeholders from the coordinator to the undergraduate student.

Rotation

Another stage that required intervention within the scope of the findings obtained from the research data was the school or class change of the students taking the teaching practice course. Teacher 7 explained this situation with the following statements: "They can see, for example, the Work School for half a semester, but in the other semester, they must see the first second level or special subclass." Therefore, the classes in which they were placed within the scope of the teaching practice course were changed twice each semester, while the schools were changed once a semester. Three meetings were held with the department head and his/her assistants, the teaching practice coordinator, and the validity committee regarding the rotation. The ideal way was sought so that school and class changes would not cause confusion and workload. At this stage, three alternatives were considered: academics moving to a different school with the undergraduate student group every semester, only students changing schools, and both. The suggestion of only students changing schools was presented to the validity committee for implementation. However, the committee members proposed a new alternative for undergraduate students to gain more diverse professional experience. It was decided that undergraduate students would carry out teaching practice in two different classes in the same school in one semester, and in the second semester, they would be placed in a new school (III. Validity Committee Decisions, 02.01.2020, p. 16). It was suggested that classroom changes within the same semester should be made at different levels as much as possible. With this decision, it was ensured that both the faculty members continue to teach in the schools where they conduct the practicum course, and the undergraduate students see four different classes in one academic year.

The Teaching Practice Process in the Department of Education of the Gifted and Talented

Faculty members working in the department of gifted education were involved in the teaching practice process for the first time in the year the research was conducted. The fact that the process was to be carried out for the first time brought along important uncertainties and problems (Researcher Diary, 24.07.2019, p. 4). The main problem encountered in this process is related to the realization of the teaching practice in classes with gifted students. Currently, general education classrooms are not available for selection by undergraduate students in the special education teaching program as part of their teaching practice. For this reason, it is not possible to assign undergraduate students to general education classes through MEBBIS. The views of faculty member 2 on this issue are as follows: "Until today, gifted students were evaluated under the classroom teaching program. However, with the merger of special education, they were included in the field of special education. Normally, these students should continue their teaching practice in general education classes, but we cannot." Initially, students were placed in the project school with which the Department of Gifted Education had a protocol. However, since there was no official basis, undergraduate students had to continue their teaching practice in special education classes after two weeks. The MEBBIS ministry official was contacted for the solution to this issue. In the interview, the official said, "The Practicum Student Evaluation (IPE) system is an element that makes the teaching practice regular and systematic and ensures that it is monitored. At this point, the functioning of MNE does not involve individuality". At this stage, the dean's office of the university where the research was conducted was also informed about the issue. In the meeting with the ministry official, it was stated that it was not possible to carry out teaching practice without a permission process and that the ministry could not make such an arrangement for students who chose a small number of subfields of gifted education (Researcher Diary, 14.01.2020, p. 18). After the meeting with the dean's office, a validity committee was organized to evaluate and decide on the final situation. As a result of the evaluation carried out in the validity committee, it was decided that undergraduate students who chose the sub-field of education of the gifted will continue their teaching practice in special education classes, including the fall semester of the current 2019-2020 academic year (IV. Validity Committee Decisions, 09.01.2020).

Team Building Effort

The findings obtained from the data showed a communication gap between the practicum instructors involved in the teaching practice in special education. Faculty member 5 expressed this situation: "Everyone is doing something, but no one knows about each other. We should be more aware of each other". Faculty member 1, who had a similar view, stated after the semi-structured interview recording was closed, "Not every academic is interested in the teaching practice; departments work independently of each other" (Researcher Diary, 04.07.2019, p. 3). In order to realize effective teamwork, this cycle consists of the steps of preparation, building a bridge between the staff, establishing a commission to improve the quality of implementation, the end-of-term meeting of the implementation coordinators, and making decisions about the next semester.

First of all, an e-mail group was established to ensure communication between the faculty members who are the implementation coordinators and the implementation coordinator ship. In addition to this e-mail group that provides the communication network, it was aimed to form a representative committee and to ensure the necessary coordination between the instructors. For this purpose, it was decided to establish a commission to increase the quality of practice in the planned intervention process (Researcher Diary, 18.12.2019, p. 15). The purpose of establishing the commission was planned to be the spokesperson of the personnel involved in the teaching practice in each faculty member's own department and to convey their problems, to offer solutions by identifying situations that the department chairmanship or practice coordinator ship could not notice, and to convey the progress and problems, if any, in the schools where the practice is carried out. The Commission held its first meeting with six members, one from each sub-field of special education. As a result of the meeting

- Review of compulsory courses,
- Failure to complete four observations in one period,
- Reducing the number of observations or dividing student groups into two,
- Changing the average of 70% teachers and 30% academics in the general scoring system and increasing the average of academics,
- Changes in the content of theoretical courses,
- The digitalization needs of the department,
- Suggestions such as good practice examples should be presented to undergraduate students were included (Quality Enhancement Commission Meeting Minutes, 25.12.2019).

The validity committee approved the recommendations presented by the commission, and an end-of-semester meeting was organized to announce them to the department staff and to receive their opinions. In this meeting

- Removing a school in the practice school pool from the system and not sending teacher candidates to that school,
- Directing a faculty member who has studies in this field to an institution that provides education to preschool-age special education students,
- Directing faculty members who do not have a vehicle to closer schools,
- Placement of teacher candidates in schools with vacancies in more central locations,
- Adding faculty members who want to conduct teaching practice courses to the system,
- Dividing the groups into two for faculty members who cannot complete four observations,
- Faculty members with different workloads can drop the course for this semester,
- Determination of letter grades for the teacher practice was listed as follows.

After the meeting, all the items were discussed with the researcher, the advisor, and the deputy heads of the department. It was decided that the researcher would make new arrangements for all of the items (Researcher Diary, 13.01.2020, p. 18). Within the scope of the arrangements, the faculty members in the kindergarten providing preschool education were directed to a different school. In that school, a faculty member with studies in this field was assigned to conduct the course. The school that was requested to

be removed from the implementation pool was removed from the system due to its lack of a systematic system and the absence of forms such as individualized curriculum (IEP) and rough assessment, which were expected to be ready for implementation, its unusual functioning, and problems with the deputy principal. In addition, care was taken to place non-intermediary faculty members in more central schools. Similarly, care was taken to ensure that students were not placed in more distant schools before the vacancies in the center were filled (V. Validity Committee Decisions. 13.02.2020, p. 21). Another regulation was to lower the letter grades to 90-AA and then to 85-AB, five by five. Since it was understood that there were many differences of opinion on this issue and that confusion could arise, it was decided to add this article to the directive (Researcher Diary, 29.11.2019, p. 12).

Developing Theoretical Infrastructure

On March 11, 2020, when the World Health Organization declared the Coronavirus pandemic, formal education was suspended, and online platforms were switched to online platforms. Therefore, research has gained a new dimension. Since completely new problems and solutions were needed with the pandemic, a new planning and intervention process started. The step of developing the theoretical infrastructure can also be defined as the period covering the shock process experienced by the announcement of the pandemic. In this period, when the authorities at all levels of education and training are busy with shock, panic, and question marks, the researcher is trying to find answers to the following questions (Researcher Diary, 26.03.2020, p. 24).

- How will online education be conducted?
- In particular, how can the teaching practice process be carried out online?

As a result of these inquiries, the researcher prepared a short report in light of the findings regarding the completion of the current semester and presented it to the validity committee. Among the findings obtained during the formal education and transition to the online process, it was understood that undergraduate students lacked theoretical knowledge. As a matter of fact, Teacher 6 described the situation as "For example, students who did not take a concept teaching course and did not know applied behavior analysis." Teacher 11 stated, "They are worse than every year's level, it seems like they could not get efficiency from the lessons." Undergraduate Student 2 stated, "There were places where the courses overlapped, and we could not take these courses." Therefore, it was suggested and approved by the committee to complete the semester with webinars that would improve the theoretical background of the students (VI. Validity Committee Decisions, 26.03.2020).

After analyzing the interview transcripts from teachers and undergraduate students, it became clear that there were deficiencies in teaching concepts, error-free teaching methods, social skills instruction, and career support. The cycle of developing the theoretical infrastructure consisted of preparation, implementation, and evaluation of the sessions. In the preparation phase, support was obtained from competent lecturers in the relevant fields to conduct the webinars. At this stage, students who did not take the teaching and method courses were reached through the teacher practice coordinators.

The sessions of the informative seminars, the preparations of which were completed, were started at 13:00 and completed at 17:45 with two ten-minute breaks.

The guest lecturer first gave a presentation on the concept of teaching interactively with undergraduate students. This session lasted approximately 60 minutes. In this session

- Methods used in concept teaching
- Concept analysis
- Planning and implementation of concept teaching
- Good practice examples were included.

After a short break, the session on error-free teaching methods was held. The second session lasted approximately 80 minutes. In this session;

- Reminding the concepts related to applied behavior analysis
- Definition of error-free teaching
- Fixed waiting time teaching
- Simultaneous prompting
- Increased standby teaching
- Teaching with pre-behavioral prompting and testing
- All teaching methods, such as social skills teaching, were included.

After answering the students' questions, the instructor completed the session and left the interview. The last session was conducted by the researcher. In the session called career support seminar, the topics that students were curious about in their professional careers were discussed with a presentation. In this session;

- Types of public and private institutions in special education
- Working conditions of institutions
- Personal rights of employees
- The rights of private institutions were included.

With the transition to distance education after the pandemic, the studies carried out with the undergraduate student group in the study were completed in the fall semester of 2019-2020. After this group graduated, a new process involving distance education was started with fourth-year undergraduate students who will take the teaching practice course in the 2020-2021 academic year.

Transforming Theory into Practice (Transfer)

Due to the ongoing effects of the pandemic in the 2020-2021 academic year, educational institutions have adopted a distance education approach. For this reason, under the guidance of the validity committee, planning was made to carry out the teaching practice with distance education. The planning is in the form of material design for students with special needs in the distance education process and the transfer of these designs to the real environment. As a matter of fact, Undergraduate Student 9 said, "We know the mind, but we don't know how to prepare materials for the field of special education. Like hearing, like vision, teacher." and Undergraduate Student 16 said, "The field is united after all. We have the possibility to work everywhere. We need to be able to prepare materials for all kinds of children." The cycle of transforming theory into practice consists of preparation, lectures, student material presentations, EBA sessions (transfer), and evaluation steps.

In the preparation phase, a 12-week syllabus for the material design and instructional technologies course to be conducted in the fall semester of the 2020-2021

academic year was created and approved (VII. Validity Committee Decisions, 09.04.2020). The syllabus is given in Table 4.

Table 4

Material Design and Instructional Technologies Course Syllabus

Session	Date	Topics	Content
1	07.10.2020	Planning	Sharing what will be done during the semester and the course operation
2	14.10.2020	Calendar Teaching	Calendar activity and use for students with special needs Students' calendar presentations
3	21.10.2020	Story Baking	Items to be considered in the preparation and use of storybooks for students with hearing loss Students' storybook presentations
4	28.10.2020	Material Design for Science Teaching	Preparing an experiment book for students with hearing loss Students' experiment book presentations
5	04.11.2020	Material Design for Literacy Teaching	Text analysis and voice teaching for students with hearing loss Students' presentations of text and audio work
7	11.11.2020	Material Design for Mathematics Teaching	Division with and without remainder Students' presentations of division material
8	26.11.2020	Material Design for Preschool Period	Elements to be considered in material design for students with special needs in preschool age Presentation of preschool materials by students
9	30.11.2020	Material Design for Students with Visual Impairment	Items to be considered when preparing materials for students with visual loss Presentation of materials prepared by students for students with visual impairment
10	03.12.2020	Development of Materials Involving the Use of Technology	Preparing sequential cards using Storyboardthat program Presentations of the materials prepared by the students using Storyboardthat program
11	09.12.2020	Development of Materials Involving the Use of Technology	Making a video using the Plotagon program Presentation of videos prepared by students with Plotagon program
12	23.12.2020	Development of Materials Involving the Use of Technology	Period evaluation

As given in Table 4, material development sessions were held in the areas that undergraduate students needed. The first session was held on 07.10.2020, and the last session was held on 23.12.2020. The process started with lesson planning, continued

with material design in various fields and subjects, and ended with video content preparation for students with special needs. Before the researcher's informative sessions on the topic of the week, undergraduate students presented the materials they prepared within the scope of the topic covered in the previous week. The whole process, from the planning of the lesson to its finalization, was carried out in a similar way. Examples of materials prepared by undergraduate students are given in Visual 1.

Visual 1

Examples of Materials Prepared by Students

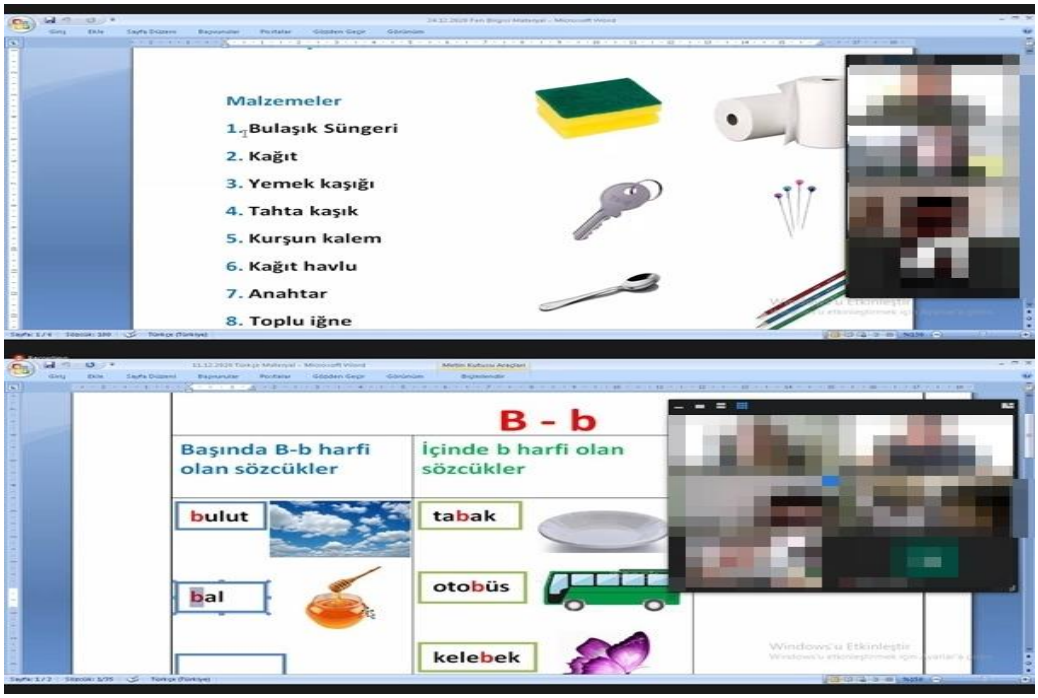
Each undergraduate student prepared a total of 11 materials during the semester. The two examples selected in the visuals were chosen from the materials that the students presented after the sequential card preparation and video content preparation courses using technology. A screenshot of the material prepared as a video was taken and added to the visual.

While the instructional technologies and materials course continues, teacher practice courses are conducted through EBA and Zoom. The process of transferring the theoretical knowledge learned in the instructional technologies and materials course of undergraduate student 24 to the real teacher practice environment was observed and evaluated.

EBA lessons were conducted with the participation of the researcher, undergraduate student, and teacher 12. The online courses were conducted in an online classroom for fourth-grade children with hearing loss. There were six students in the class, including two children diagnosed with mild intellectual disabilities. The students were involved in the process within the framework of Teacher 12's lesson program, and 24 undergraduate students prepared plans and materials on the topics the teacher gave and carried out their practices.

Visual 2

EBA Lesson Visuals



In the visual, there are video recordings taken from two different lessons. The first video recording was taken from science (classification of substances), and the second from Turkish (phonics). Undergraduate Student 24 observed the students in the classroom for two weeks before starting the implementation. She tried to determine students' academic level with hearing loss by observing them for 12 hours two days a week. Information about the lessons on EBA is given in Table 5.

Table 5

Information on EBA Sessions

Session	Date	Lesson	Topic
1	11.12.2020	Turkish	Sound Teaching
2	17.12.2020	Mathematics	Geometric Objects
3	24.12.2020	Science	Classifying Substances
4	31.12.2020	Mathematics	Currencies
5	07.01.2021	Social Studies	Neighboring Countries
6	08.01.2021	Turkish	Emergency Teams (Sequential card)

Table. 5 shows that six EBA sessions were conducted. In the sessions, 24 undergraduate students prepared based on the instructional technologies and materials course teachings in Turkish, mathematics, science, and social studies. All sessions lasted 20 minutes. The lessons were observed and evaluated by the researcher and the classroom teacher.

In the cycle of transforming theory into practice, the evaluation step was realized in two dimensions. Instructional technologies, material design courses, and EBA sessions were evaluated with different criteria. In evaluating the materials prepared by

undergraduate students within the scope of the course, the academic level of students with special needs and the criteria of suitability to the characteristics of the disability group were taken into consideration. In addition, the materials were evaluated every week during the presentations with the criteria of size, comprehensibility, visuality, design, and economy. Undergraduate students also shared how they planned to use their materials during their presentations. In this context, the appropriateness of the prepared material to the determined aims and objectives was also evaluated. During the EBA sessions, the development of Undergraduate Student 24's teaching skills and the transfer of the teachings in the instructional technology course to the real practice environment were evaluated. After each session, the development process was evaluated by the researcher and Teacher 12. First, Undergraduate Student 24 evaluated herself, then the researcher and the teacher shared their observations. Undergraduate Student 12 was quite successful in some areas from the beginning of the process. For example, the classroom teacher said, "His plans and materials are always good, he is very devoted in this regard...". However, it was observed that support was needed in some areas. In the beginning, Undergraduate Student 24 had difficulty controlling the classroom because the lessons were online. She started to conduct more controlled lessons by considering the feedback given by the researcher, such as "Try to make more interesting moving materials, draw attention with your tone of voice from time to time, speak monotonously, force students to participate in the lesson." In the general evaluation made with the classroom teacher, the statements "He improved every day, how can I say, despite distance education..." showed that the process progressed as desired.

In addition to trying to improve the teaching skills of undergraduate student, the courses also had indirect benefits. In the post-lesson evaluations, the researcher asked undergraduate student 24 the question, "How did you make this material?" and asked her to show it briefly on the computer. The aim here was to support Teacher 12 in preparing materials with instructional technologies through implicit learning. As a matter of fact, it was understood that progress was made towards this goal at the end of six weeks. The opinions of Teacher 12: "I learned it too, thanks to him, I know we are old, but you need to improve yourself, you encounter everything at any time" support this opinion.

Third Phase: Monitoring and Evaluation (09.01.2021-29.01.2021)

After the completion of the implementations, the monitoring and evaluation phase started. At this stage, it was decided to review the practices carried out within the scope of the research in the interviews held with the thesis advisor and the validity committee. In the review process, it was aimed to interpret and evaluate the practices realized by conducting final interviews with the research participants. For this purpose, it was decided to conduct final interviews with faculty members, teachers, undergraduate students taking instructional technology and material design courses, and undergraduate students and teachers who conducted EBA sessions (IX. Validity Committee Decisions, 10.01.2021).

Before the Pandemic

Three sub-themes were found in the theme of evaluating the practices before the pandemic. These sub-themes are opinions about the teaching practice before the

research, opinions about the practices carried out during the research process, and problems and solutions in the teaching practice process.

Since the teaching practice will be carried out for the first time after the unification of the special education program, the opinions are generally positive. Because for many years, a systematic teaching practice process has been carried out in sub-fields such as education of the mentally disabled and education of the hearing impaired. As a matter of fact, Lecturer 3 stated this situation as follows: "We had a system. Hearing was unaware of the mind, the mind was unaware of hearing, but everyone was conducting it within their own system." However, opinions change completely when asked about the current situation as the 2019/2020 Fall Semester approaches after the merger. Faculty Member 1 stated, "There should not have been such a transition. There was no preparation, so no one knew what was going to happen. There is a flood of questions but no answers, you know what I mean" is one of the best examples of the negative atmosphere. Faculty Member 6 stated that the merger process was sudden and unplanned with the views, "I mean, it could have been done with a pilot practice, this chaos also turned the existing system upside down."

Opinions about the practices carried out during the research process were generally positive. Faculty Member 4 stated that "Many new decisions were made, and practices were implemented. Of course, some things would have happened even without the research. But it would have happened with a meeting between the lecturers. Stakeholders' opinions were taken and researched, and that's how it was done. I think it was much better with the research." It is understood that the contribution of the research to the organization of the system is important. Faculty Member 7 said, "If we look at it scientifically, it seems like an original study. A new process is a subject that has not been studied. From our point of view, we conveyed almost every problem we had. Some of them were solved, and some were not, but I think it was good that the beginning was like this, it was not left in the air. There may be follow-up studies." She stated that the research could be a guide to the literature and subsequent research.

The issues mentioned in the sub-theme of problems encountered within the scope of the research and solutions for eliminating these problems are frequently related to cycles. As a matter of fact, the preparation of the teaching practice guide during the rotation process was evaluated as a functional practice by all faculty members. For example, Faculty Member 7 said, "Evaluation forms were very good. Grading was one of the most complicated issues." On the other hand, it is seen that the directive on special education teaching practice, which is another section in the manual, prevents confusion. Faculty Member 3 said about the directive: "We were at the beginning of a very messy process. I think it was like a road map. I think it was an important move of the research."

After the Pandemic

Three sub-themes were reached in the main theme of evaluation of the practices carried out after the pandemic. These sub-themes are opinions on teaching practice after the pandemic, opinions on the practices carried out within the scope of the research during the pandemic process, and problems and solutions in the pandemic process.

Following the pandemic announcement, the teaching practice process in the special education program has gained a new dimension. In order to understand the current situation, the expressions of the participants whose opinions were taken were generally in the direction of a new complexity. Teacher 9 described this situation as follows: "There was no infrastructure, of course, we did not know what to do at first. Special education and distance education are very difficult things. We don't know what teacher candidates should do", emphasizing that a difficult process will start again. Undergraduate Student 5 from the first group of special education graduates (2019/2020 Spring Semester), whose teaching practice was left unfinished after the pandemic announcement, stated the following opinion: "We were already having difficulty in practice, in fact, it was distance education, it went without practice in two months." It has become clearer how distance education will take place in the new academic year (2020/2021 Fall Semester) that started with the continuation of the Covid-19 Pandemic. The opinions of undergraduate students taking the teaching practice course are generally related to how they will carry out an effective learning and teaching process with distance education. For example, Undergraduate Student 16 said, "Online practice was not good, teacher. Maybe the most important part of the school. How will we prepare materials, let's do it, how will we teach the lesson." On the other hand, Faculty Member 7 said, "There was a new practice that we just got used to. Now that the pandemic has come out, things are settling down, it will be even more difficult now. Who knows how long it will last." She stated that the teacher practice process after the merger of the special education program became more complicated with the pandemic.

In the last interviews, the participants were also asked questions about the practices carried out during the pandemic process. Undergraduate students and teachers generally thought that the practices were useful and functional. Undergraduate Student 18, who took the instructional technologies and material design course, reflected on this situation with the view, "It was an intense content, but we are sure that you will benefit from it." On the other hand, Undergraduate Student 4, who participated in the sessions to strengthen the theoretical infrastructure held at the beginning of the pandemic, stated, "I was feeling incomplete, to be honest, although I still have a concern, we needed such an organized course, it was a hit." Teacher 12 expressed his views on the transfer process related to EBA sessions as follows: "It was an orderly, systematic progress, teacher, I think it was good for myself and for the student. It was not done for the sake of being done, I mean, I felt like a real internship, even from a distance". Faculty member 6 said, "I think whatever can be done remotely was done. I mean, teaching practice is a live-blooded process, so I think the students were satisfied, frankly." He stated his opinion. In this direction, it is thought that the stages of developing the theoretical infrastructure and transferring this knowledge to the real practice environment in light of the data collected before and after the pandemic are functional.

The last heading in the monitoring and evaluation theme includes the problems experienced during the pandemic process and the solutions produced for these problems. It is seen that the fact that the post-pandemic teaching practice will be carried

out through distance education causes anxiety and uncertainty among stakeholders such as undergraduate students and teachers. Within the scope of the research, it was tried to realize the closest teaching practice course to the ideal. Participant opinions regarding the solutions employed for the problems encountered in this endeavor are quite positive. As a matter of fact, Teacher 12 said, "We fell into a chaotic situation. I wasn't sure if those who came for the practicum would come just for the sake of it or if they would be able to do something. We have many years of experience, but distance education is a difficult job, this is a special education class. But I was very satisfied. The student improved day by day and did more than his/her best." statements support this impression. On the other hand, Undergraduate Student 24's statement, "At first I did not know what to do, but as I progressed, I gained self-confidence. My knowledge increased, and the feedback was useful. There was always a problem, but it was always solved. I feel more ready for teaching" are similar to the teacher's views. Undergraduate Student 20 said, "It was very good to find someone we could tell our deficiencies and weaknesses and get support. Compared to other groups, we saw hundreds of material examples in one semester. At first, I felt like I didn't know anything", she commented on her individual development. Finally, among the problems observed within the scope of the research is the lack of technological knowledge of the classroom teacher as well as the undergraduate students. The sessions on EBA also contributed to the technological development of the classroom teacher. Teacher 12 summarized this contribution by saying, "Of course, MNE had prepared an infrastructure for the lessons, but beyond that, I have seen many applications from applications where I can use the blackboard to animated content."

Discussion

In 2014, the Ministry of National Education's Board of Education decided to appoint graduates of teaching programs in hearing impairment, mental disability, and visual impairment as 'special education teachers' by amending the Principles of Teaching Fields, Assignments, and Course Teaching. Accordingly, in 2016, CHE announced a new special education teaching program by combining all subfields at the undergraduate level. Learning disabilities and autism spectrum disorder education were added to the special education teaching program. Within the scope of the research, the participants' opinions regarding the unification of all sub-fields as a single undergraduate program under the umbrella of special education teaching were taken. It was understood that the stakeholders participating in the research had different opinions about the new special education program. In this direction, different evaluations were included according to the perspectives of faculty members, teachers, undergraduate students, and MNE officials.

In the focus of the teaching practice course, the research findings show that the implementation period is short. In the literature, there are many research findings that the teaching practice course duration in special education is insufficient (Aydın & Şentürk, 2021; Güleç-Aslan, 2014; Karabıyık & Uğurlu, 2019; Ulay, 2018). In addition, there were problems in placement in schools structured according to the type of disability in accordance with the sub-fields chosen by the students. In their study, Büyükalan Filiz et al. (2018) predicted that the duration of teaching practice would not be sufficient, there would be problems in school-student matching, and there would be

insufficient faculty members to conduct the course. As a matter of fact, this prediction coincided with the findings of the study. Participants considered the implementation periods of the new special education teacher training program inadequate. The main reason for the problem in school-student matching is that there are two universities with special education departments in the province where the research was conducted. Lack of communication between universities causes conflicts in placements. Due to the research assistants who are on the staff of different universities and who continue their postgraduate education in the department where the research was conducted, there was no problem regarding the insufficiency of faculty members. However, it is foreseen that this problem will be on the agenda in the coming years. At this point, the number of students admitted to the special education teaching program may be reduced.

Among the aims of education is for individuals with special needs to become self-sufficient, acquire independent living skills, and integrate with society. In order to improve the life functions of individuals, instructional arrangements are needed. One of the methods used to help individuals gain independent living skills within the scope of instructional arrangements is incorrect teaching methods (Aksoy, 2019). In the special education teaching program, it is seen that the errorless teaching method course is defined as an elective course. False teaching methods are among the effective methods for teaching skills and behaviors to individuals with different needs in various age groups (Tekin, 1999). Most of the teacher participants of the study stated that the undergraduate students who took the teaching practice course after the special education teaching program did not know or did not know the errorless teaching methods. It was determined that undergraduate students generally did not take this course. In this context, it may be considered to make this course compulsory for undergraduate students who choose the subfields of education of the mentally disabled and autism spectrum disorder education.

Ulay (2018) evaluated the merged special education teaching undergraduate program in the context of the competencies of teachers of the mentally disabled. As a result of the evaluation, changing the concept of teaching courses as compulsory courses is among the recommendations. A similar finding was found in this study. It was observed that senior undergraduate students who completed their theoretical education in the new program and passed the teaching practice stage did not take the concept teaching course because it was in the elective category. It was determined that the lack of knowledge about concept teaching, especially pointed out by the teacher participants, was tried to be overcome during the practice. In parallel with Ulay's (2018) suggestion, it is considered necessary to include this course in the compulsory course category, at least for undergraduate students who choose the sub-fields of education of children with ASD and education of the mentally retarded.

Karasu et al. (2014) examined the changes that need to be made from the teachers' perspective in the teaching program for the mentally disabled. Their findings include creating new alternatives by increasing the number of elective courses, enriching the course content, and increasing the practice opportunities. It is seen that the new special education teaching program has made changes that overlap with these findings. It is understood that elective course alternatives have been increased considerably, and course contents have been enriched according to the teacher training program for the mentally disabled. However, contrary to the findings of Karasu et al.

(2014), it is seen that practice opportunities are limited. There are two teaching practice courses for undergraduate students who are expected to acquire teaching skills in six sub-fields. Within the scope of the research conducted, it is reported that practice opportunities have become more inadequate compared to the old program, especially in the opinion of teacher participants.

After the unification of the special education teaching program at the undergraduate level, one of the priority issues that came to the agenda was quality. In order for the students who will graduate from this program to be seen as a qualified special education teacher, attention is drawn to the necessity of increasing the practice periods, revising the program content, and the obligation of faculty members to give courses within the scope of their own expertise (Büyükalan Filiz et al., 2018). The findings obtained within the scope of the research show that in order to train teachers who have mastered all sub-fields of special education, practice hours and duration should be increased. As stated in the previous paragraphs, courses that are considered elective courses should be recategorized as compulsory courses. Büyükalan Filiz et al. (2018) state that with the new curriculum, the initiative to be trained in a qualified way is left to the students' choices through elective courses, albeit partially. Special education teachers should be adequately equipped in the education and training processes of students with special needs (Billingsley & McLeskey, 2004; Özyürek, 2008). The undergraduate students who participated in the study stated that they did not see themselves as a special education teacher with adequate equipment. In this direction, there is a need to review the program and make arrangements in light of scientific data.

Some of the participants also had positive opinions about the current situation after CHE announced the new special education teaching program. Some of the participants consider the new program, which is organized in parallel with the appointment criteria of the Ministry of National Education, to be applicable, provided that they also express its shortcomings. On the other hand, they also stated that this program is a need. It was stated that there is a need for a unified special education teaching program because, in the old programs, teachers were appointed as teachers without taking into account the special education field they graduated from. In the study conducted by Büyükalan Filiz et al. (2018), some participants stated that the old program did not provide teacher candidates with the skills to teach students in different disability groups and that the new program was formed in line with the need and met the expectation to meet the teacher shortage in the field of special education. In the current study, participants who were special education teachers generally had negative attitudes towards the merged program. Faculty members, on the other hand, besides their positive views, think that a pilot study or gradual implementation would be a more systematic approach. In summary, no matter how and in what form the special education teaching program is implemented, it is important to make it more qualified by focusing on solving problems and meeting the needs since it is already being implemented in universities.

Teaching practice, which can be considered the last step of pre-service education, is defined as a period of time in which final undergraduate students study in a classroom appropriate to their field of specialization, with an experienced teacher and/or faculty member acting as a guide (Eurydice, 2018; Van Schagen Johnson et al., 2017). Within the scope of the research, the first problem encountered in the teaching practice

process was rotation. All participants, especially teachers and undergraduate students, requested rotation during the teaching practice process in order to gain more experience and get to know students and teachers. This request was not left unanswered, and a system was established in which they could carry out the practicum in a new classroom each semester with new teachers and faculty members. During the practicum, senior undergraduate students have the opportunity to apply and reflect on the theoretical knowledge and skills they have acquired throughout their education in a real-world environment (Conderman et al., 2005; Hurioğlu, 2016; Woods & Weasher, 2003). On the other hand, the new special education teaching program facilitates the transition between subfields (Büyükalan Filiz et al., 2018). Meeting the demands for a transition to different fields without causing confusion has become easier with rotation. With the realization of rotation, undergraduate students had the opportunity to transform their theoretical knowledge and skills into practice in different environments and classes in the subfield they specialized in or in the same field.

Instructors have stated that newly graduated teachers have the necessary theoretical knowledge and theoretical infrastructure. However, they will have difficulties in their professional development because they cannot find enough opportunities to test and develop this knowledge in practice in undergraduate education (Aksoy et al., 2018; Kış et al., 2017). In this study, similar findings regarding teaching practice and contrasting findings regarding theoretical knowledge and theoretical background were found. Some of the participants, including senior undergraduate students, think that their theoretical knowledge and theoretical background are not sufficient. However, it is seen that the main reason underlying the insufficiency is the course choices of undergraduate students. It was determined that even the courses related to their chosen subfields of specialization were not taken if they were not compulsory. Another research finding of Kış et al. (2017) is that teachers are not taught professional development models. It can be stated that professional development models have gained more importance in the new program in which choices other than compulsory courses are left to student preferences. Adding course content related to these models to the first year of the undergraduate program will indirectly benefit students' professional development in the future.

Aydın and Şentürk (2021) compared the new special education teaching program with the old program that produced graduates in terms of departments. The participants who graduated from the old program emphasized that the program content contained inefficient and inadequate practice courses, that they were not trained at the desired level in family education, and that it was insufficient to meet the problems and needs encountered in professional life. In addition, they evaluated the curriculum content and academic staff as inadequate. Regarding the new special education teaching program, 65% of the participants expressed negative opinions. In this study, similar results were observed regarding the unification of special education. However, it should be noted that only some of the teachers expressed negative opinions. The striking finding in Aydın and Şentürk's (2021) study is that although most of the participants expressed negative opinions about the new program, only 6% of the participants were informed about it. To put it briefly, many of the participants both criticized the old curriculum and expressed negative opinions about the new curriculum without knowing the details. The most common suggestion for the solution to the consequences of this

critical view is to increase the quality and quantity of practice. Although the results regarding the teaching practice are similar to the study, it can be stated that contrasting findings were reached in terms of course variety and content.

After the pandemic, the teaching practice course was conducted on the EBA platform. The Zoom program was defined on EBA, and relevant faculty members also participated in the lessons. Among the implicit benefits of the research in the distance education process is the development of the teacher in whose classroom the teaching practice was carried out. In her study, Sertkaya (2021) found that special education teachers' self-efficacy regarding the use of technology was at a high level. However, contrary to this finding, it was observed that the teacher did not have sufficient knowledge and equipment about the programs that can be used in the e-learning process, preparing materials, and using these materials in distance education. Therefore, evaluations were made after each lesson to improve the teacher's technological knowledge and equipment. In addition, the construction process of the materials used in the lessons was introduced in a way to include each stage.

Karasu et al. (2014) emphasized the necessity of revising the teacher training program in special education before the special education department was merged due to changing student profiles and types of disabilities, and technological developments. In addition, he emphasized that producing materials was one of the most difficult subjects for teachers who graduated from the old program. Although the special education teaching program has changed, it is seen that no progress has been made in technological development and material issues. In the research conducted, especially with the opinions of undergraduate students, it was understood that it was difficult to prepare materials according to the types of disability. With the pandemic, the inadequacy of the technological infrastructure and the lack of knowledge and equipment in reflecting instructional technologies to the field have come to light, as expressed in the study of Karasu et al. (2014). Although many studies have been carried out within the scope of the research to eliminate these deficiencies, measures to ensure continuity are needed. In particular, it is important to organize the instructional technologies and material design course with the content that traditional materials specific to all disability groups within the scope of special education can be prepared. On the other hand, the inclusion of the objectives of preparing materials using instructional technologies and realizing the lesson in accordance with the material in the course content will contribute to the relative elimination of the problems expressed.

Conclusion

As a result, it was understood that the participants had different opinions about the new special education teaching program. While special education teachers and undergraduate students are generally dissatisfied with the new program, faculty members and ministry officials think that this program is inevitable. However, many problems were encountered after the new special education teaching program. Among these problems are the inclusion of important courses as electives in the catalog, the high number of students, the small number of schools to conduct teaching practice courses, and the short duration of practice course hours. In addition, the sub-field chosen by the undergraduate students and the classes in which the practicum will take place do not match. Especially for undergraduate students who prefer to specialize in

the sub-field of gifted education, there are unsolvable problems in student-school placements. There is a widespread belief that the elective and compulsory courses in the content of the new program should be revised. The inclusion of courses such as concept teaching and error-free teaching methods within the scope of elective courses is thought to affect the teaching skills of undergraduate students in the implementation process. As a result of the research, needs were also identified besides the problems that emerged after the merged program. It was seen that there was a need for a directive to determine the rules and boundaries of the teaching practice course. In addition to the directive, it was understood that the faculty members conducting the teaching practice course needed a common evaluation form, effective communication, and cooperation. All these problems and requirements were tried to be solved to the extent permitted by the regulations, the teaching practice course guide was prepared, the rotation process was carried out, and commissions were established to ensure the systematic operation of the new program. With the pandemic, the research evolved into developing the theoretical infrastructure of undergraduate students and transforming their theoretical knowledge into practice. In this context, webinars were organized in areas such as concept teaching, error-free teaching methods, social skills teaching, instructional technologies, and material design sessions were held. It was also aimed to transfer the gains obtained from all these sessions to the ongoing teaching practice process in the real practice environment of EBA. In the sessions held in EBA, it was tried to increase the technological knowledge level of the classroom teacher as well as the undergraduate student. In the light of the data obtained within the scope of the research, the decisions taken, the results arising from the decisions, and the actions taken were monitored and evaluated. At this stage, it was concluded that the feedback was quite positive and contributed to the development of the teaching practice process after the new special education teaching program.

Implications

- The duration of the undergraduate program can be increased to five years, with three years of theory and two years of practice, so that undergraduate students can practice teaching in many sub-fields of special education.
- Similar to examples abroad (e.g., China), students who complete their bachelor's degree can complete the teaching practice process in sub-fields through a master's degree.
- In the special education teaching course catalog, concept teaching, and error-free teaching methods courses are included in elective courses. For undergraduate students who prefer to specialize in the sub-fields of education of the mentally retarded and autism spectrum disorder education, it may be suggested that concept teaching and errorless teaching method courses should be compulsory.
- For undergraduate students who choose the sub-field of education of the gifted, BILSEMs can be included among the institutions where teaching practice is carried out.
- For undergraduate students who choose the sub-field of education of gifted students, general education classes with gifted students can be included in schools where teaching practice is carried out. Classes in these schools can be considered special subclasses.

- In order for the new special education program to be implemented in a functional way, it may be recommended to increase the number of faculty members in universities with a distribution that includes experts from each sub-field.

Acknowledgements

No financial support was received from any institution or organization.

Statement of Responsibility

Yunus Yılmaz; methodology, data collection, analysis, summary introduction, findings and conclusion. Hasan Gürgür; methodology, analysis, checking and editing the whole report.

Conflicts of Interest

There are no situations that may cause financial, commercial, or legal conflicts of interest.

Author Bios:

In 2011, Yunus Yılmaz graduated from Eskisehir Anadolu University, Teacher Education for the Hearing Impaired. In 2016, he graduated from Anadolu University, Department of Special Education. He completed his master's degree in the Department of Education of the Hearing Impaired and his doctorate in the same program in 2022. The author, who has studies on teacher training in the field of special education, is currently working as a Research Assistant Doctor at Anadolu University, Department of Special Education.

In 1997, Hasan Gürgür graduated from Anadolu University Teacher of the Hearing-Impaired program. Gürgür studied at Ankara University Institute of Educational Sciences. He completed his master's degree in 2001 and his doctorate in 2005. He worked as a research assistant in various universities during his education. Gürgür is currently working as a research assistant at Anadolu University, Deaf Education Center. He is currently working as a faculty member in the Department of Education. His research interests are education of hearing-impaired children, teacher training and inclusive education applications.

References

Abazaoğlu, İ. (2014). Dünyada öğretmen yetiştirme programları ve öğretmenlere yönelik mesleki gelişim uygulamaları [Teacher training programs and professional development practices for teachers in the world]. *Electronik Turkish Studies, 9*(5), 1-46.

Aksoy, F. (2019). *Beceri öğretiminde yanlışsız öğretim yöntemleri: Öğretmenler ve aileler için uygulamalar* [Error-free teaching methods in skill teaching: Practice for teachers and families]. Ankara: Maya Academy.

Aksoy, V., Çavuşoğlu, T., & Kalaycı, G. Ö. (2018). A qualitative examination of the serviceability of teaching practice modifications aimed for special education teacher candidates. *Journal of Special Education Apprenticeship, 7*(2), 1-16.

Altrichter, H., Posch, P., & Somekh, B. (2005). *Teachers investigate their work: An introduction to the methods of action research*. London: Psychology Press.

Aydın, G., & Şentürk, Ş. (2021). Özel eğitim bölümü lisans programının birleştirilmesine yönelik özel eğitim öğretmenlerinin görüşlerinin değerlendirilmesi [Evaluation of special education teachers' opinions on the unification of the undergraduate program of special education department]. *Turkish Journal of Primary Education*, 6 (1), 36-50. doi.org/10.52797/tujped.829099

Billingsley, B. S., & McLeskey, J. (2004). Critical issues in special education teacher supply and demand: Overview. *The Journal of Special Education, 38*(1), 2-4.

Presidency Board of Education (2014). Principles of teaching fields, assignment and course teaching. Decision No:9/62. https://ttkb.meb.gov.tr/meb_iys_dosyalar/2022_10/11160806_9_cizelgeveesaslar.pdf

Bogdan, R. C., & Biklen, S. K. (2007). *Qualitative research for education an introduction to theory and methods* (5th ed.). Boston: Pearson Education, Inc.

Borgia, E. T., & Schuller, D. (1996), action research in early childhood education, ERIC *Clearinghouse on Elementary and Early Childhood Education*, Urbana IL. ED401047.

Budak, Y., & Demirel, Ö. (2003). Öğretmenlerin hizmetiçi eğitim ihtiyacı [Teachers' need for in-service training]. *Kuram ve Uygulamada Eğitim Yönetimi [Educational Administration in Theory and Practice]*, 33 (33), 62-81.

Büyükalan Filiz, S., Çelik Şahin, A., Tufan, S., & Karaahmetoğlu, B. (2018). Özel eğitim öğretmenliği lisans programlarının birleştirilmesine ilişkin öğretim üyelerinin görüşleri [Opinions of faculty members on the unification of special education teaching undergraduate programs]. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi [Hacettepe University Journal of Faculty of Education], 33*(3), 763-775. doi.org/10.16986/HUJE.2018036496

Can, E. (2020). Coronavirüs (Covid-19) pandemisi ve pedagojik yansımaları: Türkiye'de açık ve uzaktan eğitim uygulamaları [Coronavirus (Covid-19) pandemic and pedagogical reflections: Open and distance education practices in Turkey]. *Açıköğretim Uygulamaları ve Araştırmaları Dergisi [Journal of Open Education Practice and Research]*, *6*(2), 11-53.

Collier, S. T. (1999). Characteristics of reflective thought during the student teaching experience. *Journal of Teacher Education, 50*(3), 173-181. https://doi.org/10.1177/002248719905000303

Conderman, G., Morin, J., & Stephens, J. T. (2005). Special education student teaching practices. *Preventing School Failure: Alternative Education for Children and Youth*, 49 (3), 5-10.

Creswell, W. J. (2014). *Nitel, nicel ve karma yöntem yaklaşımları araştırma deseni [Qualitative, quantitative and mixed method approaches research design]*. (Trans: S.B. Demir). Ankara: Eğiten Book.

Creswell, J. W. (2005). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (2nd ed.). Upper Saddle River, NJ: Pearson Education.

Darling-Hammond, L. (2006). Constructing 21st century teacher education. *Journal of Teacher Education, 57*(3), 300-314.

Denzin, N. K., & Giardina, M. D. (2011). *Qualitative inquiry and global crises.* CA: Left Coast Press.

Dikmen, S., & Bahçeci, F. (2020). Covid-19 pandemisi sürecinde yükseköğretim kurumlarının uzaktan eğitime yönelik stratejileri: Fırat Üniversitesi örneği [Strategies of higher education institutions for distance education during the Covid-19 pandemic process: The case of Firat University]. *Turkish Journal of Educational Studies, 7*(2), 78-98. Doi: https://doi.org/10.33907/turkjes.721685

Dinkelman, T. (1997). The promise of action research for critically reflective teacher education. *The Teacher Educator, 32*(4), 250-257.

Eurydice, (2018). *The teaching profession in Europe: practices, perceptions, and policies*. Eurydice Report, Publications Office of the European Union.

Freese, A. R. (1999). The role of reflection on pre-service teachers' development in the context of professional development school. *Teaching and Teacher Education, 15*(8), 895-909. https://doi.org/10.1016/S0742-051X(99)00029-3

Gay, L. R., & Airasian, P. (2003). *Educational research: Competencies for analysis and applications*. New Jersey, NJ: Merril Prentice Hall.

Glesne, C. (2013). *Nitel araştırmaya giriş [Introduction to qualitative research].* (Trans: A. Ersoy ve P. Yalçınoğlu). Ankara: Anı Publication.

Güleç-Aslan, Y. (2014). Zihin engelliler öğretmenliği programındaki öğretmen adaylarının otizm spektrum bozukluğuna ilişkin deneyim ve algıları [Experiences and perceptions of pre-service teachers in the teaching program for the mentally disabled about autism spectrum disorder]. *Kastamonu Üniversitesi Kastamonu Eğitim Dergisi [Kastamonu University Kastamonu Education Journal], 22*(3), 869-896.

Heimerl, F., Lohmann, S., Lange, S., & Ertl, T. (2014, January). Word cloud explorer: Text analytics based on word clouds. In *2014 47th Hawaii international conference on system sciences* (pp. 1833-1842).

Hesse-Biber, S. N., & Leavy, P. (2011). *The practice of qualitative research* (2nd. Ed.). Thousand Oaks: Sage Publication, Inc.

Huberman, M., & Miles, M. B. (2002). *The qualitative researcher's companion*. New Delhi: Sage.

Hurioğlu, L. (2016). *Öğretmenlik uygulaması dersinde dönüt-düzeltmenin öğretmen adaylarının öğretimi planlama ve uygulama becerileri ile özyeterlik düzeylerine etkisi [The effect of feedback-correction in teaching practice course on pre-service teachers' teaching planning and implementation skills and self-efficacy levels.]*. [Unpublished Doctoral Dissertation]. Çukurova University, Adana.

Işık, A., Çiltaş, A., & Baş, F. (2010). Öğretmen yetiştirme ve öğretmenlik mesleği [Teacher training and teaching profession]. *Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi [Journal of Atatürk University Graduate School of Social Sciences]*, *14*(1), 53-62.

Johnson, P. A. (2005). *A short guide to action research.* (2nd ed.). Pearson.

Johnson, P. A. (2019). *Eylem araştırması el kitabı [Action research handbook].* (3rd Edition) (Trans: Y. Uzuner, M. Özten Anay). Ankara: Anı Publication.

Karabıyık, V., & Uğurlu, N. I. (2019). Zihin engelliler öğretmenliği bölümü öğretmen adaylarının özel eğitim uygulama merkezlerinde yapılan öğretimsel düzenlemelere ilişkin görüşleri [Pre-service teachers' opinions on instructional arrangements in special education practice centers.]. *Folklor/Edebiyat*, *25*(97), 591-610. https://doi.org/10.22559/folklor.970

Karasu, N., Aykut, Ç., & Yılmaz, B. (2014). Zihin engellilerin eğitimi anabilim dalı öğretmen yetiştirme programı üzerine öğretmen görüşlerinin incelenmesi [Investigation of teachers' opinions on the teacher training program of the department of education of the mentally disabled]. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi [Hacettepe University Journal of Faculty of Education]*, *29*(4), 129-142.

Kavcar, C. (2002). Cumhuriyet döneminde dal öğretmeni yetiştirme [Branch teacher training in the Republican period]. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Dergisi [Journal of Ankara University Faculty of Educational Sciences]*, *35*(1-2), 1-14.

Kış, A. T., Sarıca, A. D., & Akçamete, A. G. (2017). Eğitim fakülteleri öğretim elemanlarının öğretmen adaylarının mesleki gelişim gereksinimlerine yönelik görüşleri [Opinions of faculty members of faculties of education on the professional development needs of pre-service teachers]. *Başkent University Journal of Education*, *1*(2), 43-53.

McDuffie, A. R. (2004). Mathematics teaching as a deliberate practice: An investigation of elementary pre-service teachers' reflective thinking during student teaching. *Journal of Mathematics Teacher Education*, *7*(1), 33-61. https://doi.org/10.1023/B:JMTE.0000009970.12529.f4

Milli Eğitim Bakanlığı [Ministry of National Education] (2020). Uzaktan eğitim sürecinin detaylari [Details of the distance education process]. https://www.meb.gov.tr/uzaktan-egitimsurecinin-detaylari/haber/21990/tr

Milli Eğitim Bakanlığı [Ministry of National Education] (2021) Uygulama öğrencisi değerlendirme sistemi [Teacher practice student evaluation system]. https://uod.meb.gov.tr/

Mills, E. G. (2003). *Action research a guide for the teacher researcher* (2nd ed.). Merrill Prentice Hall.

Paker, T. (2008). Öğretmenlik uygulamasında öğretmen adaylarının uygulama öğretmeni ve uygulama öğretim elemanının yönlendirmesiyle ilgili karşılaştıkları sorunlar [The problems encountered by pre-service teachers in teaching practice related to the guidance of the practicum teacher and practicum instructor]. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi [Pamukkale University Journal of Faculty of Education]*, *23*, 132-139.

Poulou, M. (2007). Student – Teachers' concerns about teaching practice. *European Journal of Teacher Education*, *30*(1), 91-110. https://doi.org/10.1080/02619760600944993

Schmuck, R. A. (1997). *Practicalaction research for change*. Arlingston Heights, IL: Skylight Training and Publishing.

Sertkaya, F. M. (2021). *Özel eğitim öğretmenlerinin sınıflarında teknoloji ve yardımcı teknoloji kullanımına yönelik öz-yeterlik ve tutumlarının belirlenmesi [Determination of special education teachers' self-efficacy and attitudes towards the use of technology and assistive technology in their classrooms]* [Unpublished Master's Thesis]. Konya Necmettin Erbakan University, Institute of Educational Sciences.

Tekin, E. (1999). Error-free teaching methods. *Ankara Üniversitesi Eğitim Bilimleri Fakültesi Özel Eğitim Dergisi [Ankara University Faculty of Educational Sciences Journal of Special Education]*, *2*(3), 87-102.

Ulay, G. (2018). *Examining the special education teaching undergraduate program in terms of the competencies of teachers of the mentally disabled: The case of Sakarya province* [Unpublished Master's Thesis]. Sakarya: Sakarya University, Institute of Educational Sciences

Van Schagen Johnson, A., La Paro, K. M., & Crosby, D. A. (2017). Early practicum experiences: Pre-service early childhood students' perceptions and sense of efficacy. *Early Childhood Education Journal*, *45*(2), 229-236.

Woods, A. M., & Weasmer, J. (2003). Great expectations for student teachers: explicit and implied. *Education*, *123*(4), 681-688.

Yin, (2011). *Applications of case study research* (3rd ed.). Los Angeles: Sage Publications.

Yıldırım, A., & Şimşek, H. (2011). *Sosyal bilimlerde nitel araştırma yöntemleri [Qualitative research methods in social sciences]* (8th ed.). Ankara: Seçkin Publication.

Yücesoy Özkan, Ş., Öncül, N., Çolak, A., Acar, Ç., Aksoy, F., Bozkuş-Genç, G., & Çelik, S. (2019). Zihin engelliler öğretmen adaylarının öğretmenlik uygulaması dersine ve uygulama okullarına ilişkin beklentilerinin belirlenmesi [Determining the expectations of pre-service teachers with intellectual disabilities about the teaching practice course and practice schools]. *İlköğretim Online [Primary Education Online]*, *18*(2), 808-836. https://doi.org/10.17051/ilkonline.2019.562062

Yükseköğretim Kurulu [Council of Higher Education] (2016). Eğitim Fakültelerinde uygulanacak yeni programlar hakkında açıklama [Explanation on the New Programs to be implemented in Faculties of Education.]. 22.11.2019 https://www.yok.gov.tr/kurumsal/idari-birimler/egitim-ogretim-dairesi/yeni-ogretmen-yetistirme-lisans-programlari

Journal of Theoretical Educational Science, 16(3), 536-573, July 2023
Kuramsal Eğitimbilim Dergisi, 16(3), 536-573, Temmuz 2023
[Online]: http://dergipark.org.tr/akukeg
DOI number: http://doi.org/10.30831/akukeg.1268430

Deep Relationship Between the "Haha!" of Humor and the "A-ha!" of Learning: Context-Based Comic Book Development, Teacher and Student Opinions*

Mizahın "Haha"sı ile Öğrenmenin "Aha"sı Arasındaki Derin İlişki: Bağlam Temelli Çizgi Roman Geliştirilmesi, Öğretmen ve Öğrenci Görüşleri

Mustafa Kemal YÜZBAŞIOĞLU** **Mehmet Altan KURNAZ*****

Received: 21 March 2023 **Research Article** **Accepted:** 13 May 2023

ABSTRACT: The research aimed to determine the opinions of the students and the course teacher with regard to using the comic book prepared in accordance with a context-based scenario as teaching material for the science course. Phenomenology, one of the qualitative research approaches, was used for research purposes. A context-based comic book was used as course material for 12 hours in a class of 18 5th-grade students. Semi-structured interviews were conducted with seven students and a course teacher, following the implementation, using the interview forms developed within the scope of the current research. The data obtained from the interviews were analyzed by content analysis and classified under the themes of "Academic", "Affective", "Association with Daily Life" and "Comic Books and Humor". Pursuant to the results of the research, students, and course teacher declared the comic book as effective course material on the grounds that it makes the subject matter entertaining and understandable, facilitates learning, provides an opportunity for a permanent learning experience, provides an opportunity for individual learning, increases class participation, and supports the learning processes of students with literacy and language problems. Based on the results obtained, it has been suggested to use context-based comics in different units and lessons.

Keywords: Context-based learning, comic books, humor, science education.

ÖZ: Araştırmada fen bilimleri dersine yönelik bağlam temelli bir senaryoya göre hazırlanan çizgi romanın öğretim sürecinde kullanılmasıyla ilgili olarak öğrencilerin ve ders öğretmeninin görüşlerinin belirlenmesi amaçlanmıştır. Çalışmada, nitel araştırma yaklaşımlarından olgubilim deseni kullanılmıştır. Araştırmada bağlam temelli hazırlanan çizgi roman, 5. sınıfta öğrenim gören 18 öğrencinin bulunduğu sınıfta ders materyali olarak 12 ders saati kullanılmıştır. Uygulama sonrasında yedi öğrenci ve uygulama öğretmeni ile mevcut araştırma kapsamında geliştirilen görüşme formları aracılığıyla yarı yapılandırılmış görüşmeler gerçekleştirilmiştir. Görüşmelerden elde edilen veriler içerik analizi ile çözümlenerek "Akademik", "Duyuşsal", "Günlük Yaşamla İlişkilendirme" ve "Çizgi Roman ve Mizah" temalarında sınıflandırılmıştır. Araştırma sonucunda öğrencilerin ve uygulama öğretmenin çizgi romanın ele alınan konuyu eğlenceli ve anlaşılır kılması, öğrenmeleri kolaylaştırması, kalıcı öğrenmelere fırsat tanıması, bireysel öğrenmelere olanak sunması, derse katılımı artırması, okuma yazma ve dil bilme konusunda problemleri olan öğrencilerin öğrenmelerini desteklemesi gibi durumlardan dolayı etkili bir öğretim materyali olduğu yönünde görüş bildirmişlerdir. Elde edilen sonuçlardan hareketle bağlam temelli olarak tasarlanan çizgi romanın öğrencilerin öğrenmelerini desteklemesinden dolayı öğretim materyali olarak farklı ünite ve derslerde yaygınlaştırılması tavsiye edilmiştir.

Anahtar kelimeler: Bağlam temelli öğrenme, çizgi roman, mizah, fen eğitimi.

* This study was derived from the primary author's doctoral thesis.

**Corresponding Author*: Dr., Ministry of National Education, Kastamonu, Türkiye, m.kemalyuzbasioglu@gmail.com, orcid.org/0000-0001-8551-2440
*** Prof. Dr., Kastamonu University, Kastamonu, Türkiye, altan.kurnaz@gmail.com, orcid.org/0000-0003-2824-4077

Citation Information
Yüzbaşıoğlu, M. K., & Kurnaz, M. A. (2023). Deep relationship between the "Haha!" of humor and the "A-ha!" of learning: Context-based comic book development, teacher and student opinions. *Kuramsal Eğitimbilim Dergisi [Journal of Theoretical Educational Science], 16*(3), 536-573.

ISSN: 1308-1659

Contemporary teaching approaches draw attention to the significance of allowing students to take an active role in the process of knowledge construction. The idea that students will construct knowledge by directly accessing information constitutes the basis of this view. Every day a new scientific development is introduced, making it necessary for the teaching environments to keep up with the age and to search for innovations that will draw the interest of the students to the course. In this context, teachers are expected to design teaching environments that will enable students to construct knowledge in a meaningful and permanent way. However, in some cases, students may have difficulties adapting to these teaching environments and constructing the relevant subject in their minds. These circumstances lead the students to ask, "Why do I need to learn this information?" (Gilbert, 2006). An effective teaching environment should help students make connections between scientific concepts and daily life (Karslı & Yiğit, 2017; Rose, 2012; Ültay, 2012). Associating the information that students acquire at school with daily life allows the knowledge to be made more meaningful in the students' minds. (Taşkın & Moğol, 2017). However, it has been reported that students may encounter problems in associating science subjects with daily life (Gitari, 2016; Lay et al., 2013). Furthermore, students who fail to make sense of daily life problems and to construct the necessary connections with scientific knowledge cannot offer solutions to those problems (Akbulut & Çepni, 2013). The curriculum aims to equip students with the knowledge and skills necessary to solve daily life problems they may encounter (MoNE, 2018). Hence students' inability to associate scientific knowledge with daily life problems will hinder the achievement of the objectives of the curriculum. To prevent or eliminate such possible deficiencies, it is necessary to create learning environments that will enable the establishment of a relationship between the knowledge learned at school and daily life.

Context-Based Learning (CBL), which has been widely applied in recent years and also accepted in Turkey, is an approach that emerged with the aim of enabling students to establish the connection between acquired scientific knowledge and daily life (Gilbert, 2006; Sözbilir et al., 2007). The CBL approach transfers selected contexts from students' daily lives to the teaching environment (Bennett et al., 2007; Gilbert, 2006; Ültay, 2015). Thus, it is aimed to ensure the association of scientific knowledge with daily life (Fensham, 2009; Ültay, 2012) and to increase students' interests, attitudes, and motivation for the lesson (Sözbilir et al., 2007). The CBL approach further allows students to have the opportunity to see the equivalents of the knowledge they have acquired in their daily lives. Thus, students' attitudes toward the lesson develop positively, and students are motivated towards the lesson (Bennett, 2016; Ültay & Ültay, 2012). Thus, it can be said that the use of qualified teaching materials suitable for the CBL approach in the lessons will contribute positively to the learning process. Course materials within the context of CBL are prepared by teachers and presented to students (Vos et al., 2011). Countries such as Germany, England, and the Netherlands offer teachers pre-prepared contents/course materials to be used in lessons within the scope of CBL and teachers are asked to adapt these contents to their own learning environments (Pilot & Bulte, 2006; Schwartz, 2006). However, there are no/insufficient ready-made course materials appropriate for the program, as the science curriculum (MoNE, 2018) was not prepared directly in accordance with the CBL approach. If we consider the wide scope of the subject area of science, there are a limited number of

studies that include course contents, activities, and course materials for science courses prepared in accordance with CBL (e.g., Akın Yanmaz, 2021; Çelik, 2021; Hoşgören, 2018; Kara, 2016; Sari, 2010; Tulum, 2019; Ültay & Ültay, 2012). Thus, ensuring high-quality learning environments with the CBL approach also requires the need for new research from different perspectives, such as teaching by using comic books.

Today, the course materials most widely used in teaching environments are textbooks (Kılıç & Seven, 2007). Science and technology have been advancing very rapidly in the age that we live in, bringing the question of whether textbooks alone are sufficient for teaching environments. Teachers may require different materials to achieve the objectives of a curriculum. For this reason, teachers make use of various activities, contents, experiments, and course materials that will attract students' attention to the lesson and improve their motivation. It is possible to say that comic books are also partly used for this purpose. Although not widely used in science education, the popularity of comic books has been increasing every day, and comic books find a place as course material that attracts attention (Yüzbaşıoğlu & Kurnaz, 2022a). The reason for the popularity of comic books is that they directly convey the facts and experiences of the period in which they were designed (Haugen, 2005). Many factors, such as the use of images, the gestures and mimics of the characters in the script, and the setting of the plot, attract the attention of the reader (Çiçek Şentürk, 2020; Yüzbaşıoğlu & Kurnaz, 2022a). Contrary to popular belief, comics are read with interest not only by younger individuals but also by adults. It was reported that the knowledge and attitudes of individuals aged between 20-65 on the subject discussed in the comic books and their interest in learning have improved significantly (Lin et al., 2015).

Comic books are used as course materials because of their effects on the reader. One of the significant reasons regarding the use of comic books as educational material is that they present the information to the students with the integrity provided by the harmony of text and images. Textbooks alone may be insufficient in attracting and maintaining students' interest in the course as most of their content is written. However, comics have the potential to reduce the amount of text presented to the students (Affeldt et al., 2018; Ünal & Demirkaya, 2019). The students of today desire to be able to go beyond the activities performed in the classroom (James B. Hunt, Jr. Institute for Educational Leadership and Policy, 2007). This desire can be achieved with the features of comic books; thus, comic books have been considered an effective tool in attracting students' attention (Tatalovic, 2009; Yıldırım, 2016).

The use of comic books in science education, by its very nature, offers students extraordinary learning opportunities (Tatalovic, 2009) and provides the opportunity to associate daily life situations with scientific knowledge by transferring them to learning environments (Affeldt et al., 2018). In this way, students are provided the opportunities to think and discuss science subjects and concepts (Olson, 2008). Owing to the use of comic books in the classroom environment, students may experience reflections on the science-related subjects and concepts they learned at school in their daily lives. Thanks to all these features and the potential they have, the use of comic books for the CBL approach serve as a tool that will bring daily life situations to the teaching environment in an entertaining and interesting way for students. The context-based comic books presenting the reflections of scientific knowledge in daily life with a well-structured

script and plot where students can find something about themselves are thought to serve as effective teaching materials. Based on these points, the present study is aimed to reveal the opinions of students and teachers after the use of a comic, which was designed by the researchers with a context-based scenario for the science lesson in the teaching environment. To this end, answers to the following questions were sought in this research.

− What are the views of the participating students regarding context-based comics?

− What are the views of the teacher who conducts the applications with context-based comics?

Method

Phenomenology, one of the qualitative research approaches, was used for research purposes. Phenomenology studies focus on lived experiences (Merriam & Tisdell, 2015) by investigating responses and perceptions about a particular phenomenon (Fraenkel et al., 2012). It requires explaining how people perceive and define a certain phenomenon, along with revealing how they make judgments and describe it to people (Patton, 2015). For this reason, researchers conduct in-depth interviews with individuals who have direct experience to uncover the underlying structure of an experience, allowing participants to reflect on their experiences (Fraenkel et al., 2012). Thus, semi-structured interviews were conducted with the students, and the course teacher regarding the teaching practices with context-based comic books for the purpose of the present study, and their thoughts were examined.

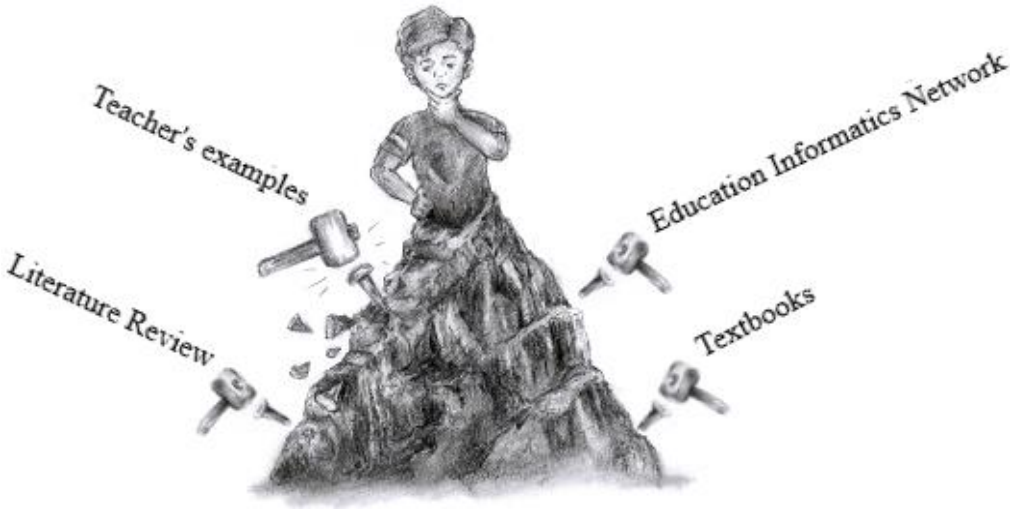
Context-Based Comic Book Development

For the research, a comic book was developed which presents a scenario consisting of contexts for measuring the force and frictional force. While developing the comic book, first, the scenario was fictionalized by considering certain situations (Figure 1).

First, the relevant literature was reviewed to develop the instructional scenario. To accomplish this, teaching practices that would contribute to the comprehension of topics such as force measurement and frictional force were explore (Doğan, 2020; Gülen & Bozdoğan, 2021; Güven et al., 2018; Hacıoğlu, 2020; Kırıcı et al., 2018; Külekci, 2019; Solvang & Haglund, 2021; Taşkın & Moğol, 2017) and the subjects that the students have difficulty in learning with their alternative ideas in this regard were determined (Canlas, 2021; Ishimoto, 2010; Kurnaz & Ekşi, 2015; Tavukçuoğlu, 2018; Yüzbaşıoğlu & Kurnaz, 2022b). Subsequently, instructional content aimed at addressing common alternative conceptions in the subject area and promoting academic success was developed.

Figure 1

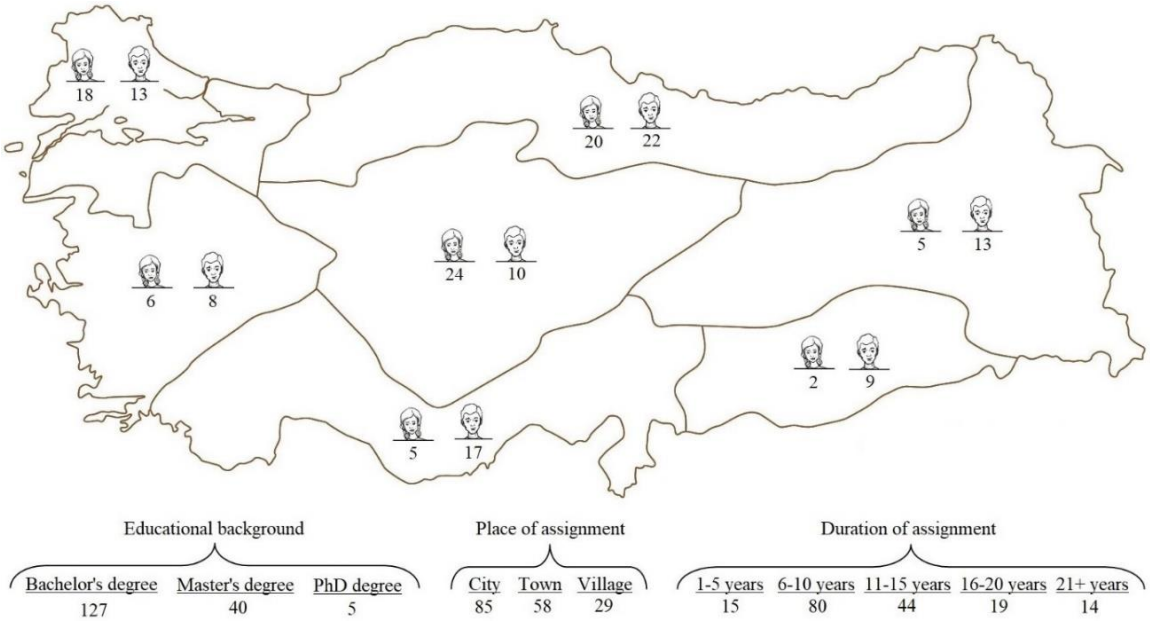
Scenario Development Stages of the Context-based Comic Book



Next, the contents and activities offered in the Education Informatics Network (Eğitim Bilişim Ağı, EBA) were examined in depth. Education Informatics Network (EBA) is a Turkish social education platform that caters to preschool to secondary education levels. It provides various learning materials, including videos, documents, e-books, tests, and activities. In addition, the contents of the textbooks used at schools were examined. These steps helped to compile the academic information required for the narrative that will be included in the scenario of the comic book.

Figure 2

Demographic Information of Participating Science Teachers



Following the preparatory step, the subsequent phase involved placing the narratives in the scenario and developing the appropriate contexts. Attention was paid to ensure that the contexts to be developed were understandable and diverse for students. In relation to this, science teachers assigned in different geographical regions of Turkey

were asked to associate five learning outcomes in the curriculum with daily life and provide examples for these associations. For this purpose, an online form was created that prompts participants to associate the learning outcomes with daily life. This form was shared with the teachers on the Internet and completed by 172 volunteer science teachers (Figure 2).

The teachers' responses were reviewed, and examples appropriate to be used for the comic book scenario were determined. The answers, which include context examples provided by the teachers regarding the learning outcomes of the science course curriculum, are presented in Table 1.

Table 1

Examples of Learning Outcome-Context Association Presented by Science Teachers

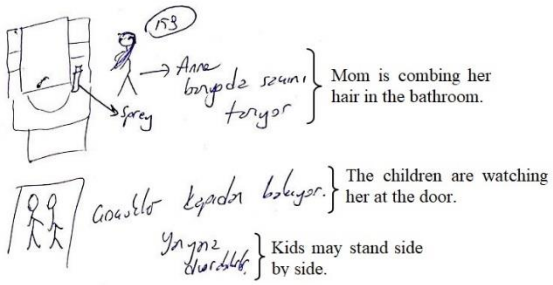
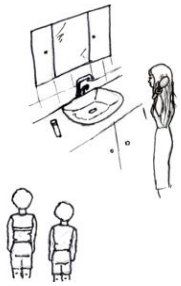
Learning outcomes	Gives examples of friction force from daily life.
Contextual Example provided by a Participating Teacher	Using hair conditioner while washing our hair and combing our hair easily without damaging is an example of reducing the friction force.

A comic book scenario was developed by making use of the context-learning outcome associations presented in Table 1 and the procedure indicated in Figure 1. Within the scope of scenario development, a plot directly related to daily life was constructed. Thereafter the main and supporting characters were designated in accordance with the storyline. Care was given to constructing characters that the reader could empathize with while determining the characters. An exemplary section on the development of the comic book scenario and the preparation of illustrations is presented in Table 2.

The Scenario, a section of which is presented in Table 2(a), along with draft illustrations, was prepared in line with the contexts developed for measuring the force and frictional force learning outcomes. Characters and events were illustrated by an expert illustrator, in line with the draft illustrations and information provided in Table 2(b). The illustration step required paying attention to make drawings suitable for the nature and elements of the comic book (e.g., Table 2(c)). The conversations between the characters were finalized after the illustrations were completed. Speech bubbles were placed in appropriate places on the illustrations, and necessary arrangements were made to separate the illustrations from each other (e.g., Table 2(d)). After all illustrations suitable for the scenario were completed, the speech bubbles of the characters were reviewed to be read from left to right and from top to bottom in accordance with the nature of the comic book.

Table 2

Exemplary Section on the Comic Book Development

Comic Book Development Steps		Example
Developing the Scenario	(a)	*The children call out to their mothers, telling them that they are ready to go out. Mom answers that she is combing her hair and is almost ready. The children step right up to their mom and ask what she puts on her hair. Mom says it's hair conditioner. Little boy asks his mother why she is applying the hair conditioner. The mother explains why.*
Preparing the draft illustrations on the scenario.	(b)	
Preparing the illustrations	(c)	
Placing speech bubbles.	(d)	

The developed context-based comic book was submitted to expert opinions to examine whether it can be used as course material in terms of language, intelligibility, learning outcomes, and context suitability. A total of eight experts, including three science instructors, a physics teacher, a language expert, a curriculum development expert, and two science teachers, were consulted for the approval of the comic book. Illustrations of some sections of the context-based comic book were detailed in line with expert opinions. Furthermore, illustrations aiming to introduce the characters were added to the introduction section. A pilot scheme was implemented in a classroom of 14 students before the comic book was finalized. Two students (one boy and one girl) in the fifth grade were asked to read the comic book and present their opinions following the necessary edits. Accordingly, the 80-page Context-Based Comic Book (CBC), exemplary sections of which are presented in Figure 3, was finalized.

Figure 3

Exemplary Sections of the Context-Based Comic Book

Teaching Implementation

The lessons were taught by each lesson's own teacher using CBC Book. The teaching process lasted 3 weeks and 12 course hours in total, and the details are presented in Table 3.

Table 3

Teaching Process

Week	Duration	Learning Outcome
1. Week	4 course hours	The magnitude of the force is measured with a dynamometer.
2. Week	2 course hours	Designs a dynamometer model using simple tools.
2. Week	2 course hours	Gives examples of friction force from daily life.
3. Week	2 course hours	Explores the effect of friction force on motion by experimenting in different environments.
3. Week	2 course hours	Proposes new ideas to increase or decrease friction in daily life.

Implementation Group

CBC Book was used as course material within the scope of a science course in a class with 18 students. The implementations were conducted by the respective teachers of each lesson. Interviews were held with teachers and students after the teaching implementations were completed. Criterion sampling method was used to determine the students to be interviewed. Criterion sampling is a method used to determine an implementation group that has sufficient knowledge and experience within the framework of the research subject and can provide a rich seam of information (Patton, 2015). For the purpose of the current research, the context-based learning status test developed by Yüzbaşıoğlu (2022) was administered to the students before and after teaching the relevant subject. The criteria were determined based on the answers provided by the students to the test, and the students were selected accordingly (Table 4).

Table 4

Criteria Taken into Account While Choosing the Students

Criterion	Gender		Total Number of Students
	Girl	Boy	
Highest score	1	1	2
Lowest score	1	1	2
Highest increase	1	1	2
Reading difficulties	1	-	1

The willingness of the students to be interviewed was also taken into consideration. S1 and S17, who provided the highest number of correct answers to the questions in the learning status test, were included in the interviews within the framework of the Highest Score Criterion. S3 and S6 were included within the framework of the Lowest Score Criterion, whereas S9 and S18 were included within the framework of the Highest Increase between the pre-test and post-test scores. On the other hand, S15 was included in the interviews due to their specific situation of experiencing difficulties in reading.

Data Collection Tools and Data Collection Procedure

The perspectives of the students and the teacher on the use of the CBC Book within the framework of teaching implementations were determined through semi-structured interviews. Comic Book Student Interview Form and Comic Book Teacher Interview Form were used for this purpose. The relevant literature was reviewed, and open-ended questions were used while developing the forms. Expert opinion was taken from two science instructors for the Interview Form developed. Some questions were revised in line with expert opinions, and the Comic Book Interview Forms were finalized accordingly. Two exemplary questions taken from the interview forms are presented in Table 5.

Table 5

Exemplary Questions from the Comic Book Interview Forms

Comic Book Student Interview Form Exemplary Question
What do you think about the use of comic books in science class?
Comic Book Teacher Interview Form Exemplary Question
What kind of reactions did you get from the students in general when you were teaching with comic books?

Comic Book Student Interview Form (see Appendix 1) and Comic Book Teacher Interview Form (see Appendix 2) constituted 10 and 6 questions, respectively. Semi-structured interviews were held with voluntary students and the course teacher following the teaching implementations using CBC Book. Interviews with the students were held in the science laboratory, in an environment where they could express themselves comfortably, and lasted an average of 10 minutes. Course teachers were interviewed in the same environment after the interviews were held with the students. The interviews conducted with the teachers lasted approximately 25 minutes. Interviews with students and teachers were.

Data Analysis

The data obtained from the answers provided by seven students and one teacher who participated in the interviews were analyzed using content analysis. Content analysis usually involves analyzing textual data, such as a breakdown of data derived from interviews. Transcribed interview recordings constitute a complex dataset, and simplifying this complexity and extracting meaningful insights from them is the challenge in content analysis. Content analysis technique includes identifying, coding, categorizing, classifying, and labeling primary patterns in data (Patton, 2015). For the current research, not all participants were asked the same questions in a uniform order throughout the semi-structured interviews. Each participant was asked further different questions in line with the answers received to reveal the participants' in-depth views on the CBC Books. The researchers took an active part in the whole process of developing codes, themes, and sub-themes after the data were transcribed. According to Patton (2015), inter-rater reliability (IRR) is appropriate for semi-structured interviews in which all participants are asked the same questions in the same order, and the data is coded at once. No inter-rater reliability check was conducted due to several reasons, including the independent coder's limited depth of knowledge compared to the researcher, the challenge of reading all the interviews, and the potential loss of richness in coding sub-themes and themes when coding superficially. The recordings of the 79-minute interviews held with the students and 24 minutes interview with the practicing teacher were transcribed. Then, the meaningful and remarkable parts of the text prepared for student interviews were coded. In the next step, a total of 49 codes were listed, and these codes were grouped under a common theme. Thus, four themes and 26 sub-themes were determined based on the codes. The themes created were reviewed again, and the themes were combined when necessary. Then the themes were refined and finalized as four themes and 21 sub-themes. The same steps were further carried out for the interview held with the implementing course teacher; accordingly, four themes and 14 sub-themes were created based on the 32 codes reached in total. At the end of

the aforementioned steps, students' opinions about CBC Book were classified under the themes of academic, affective, daily life association, comics, and humor. The opinions of the implementing course teacher were also grouped under the same theme headings. Creswell (2014) outlined various strategies developed to ensure validity in qualitative research. For the current research, the themes were derived from integrating the perspectives of the participants. Within the context of qualitative research, a detailed explanation was provided with direct quotations, detailed definitions, and multiple perspectives on each theme aiming to make the results more realistic and richer.

Ethical Procedures

This study received ethics approval from the Kastamonu University Social and Human Sciences Research and Publication Ethics Board (Dated 12.10.2020 and numbered 2020/3/40).

Results

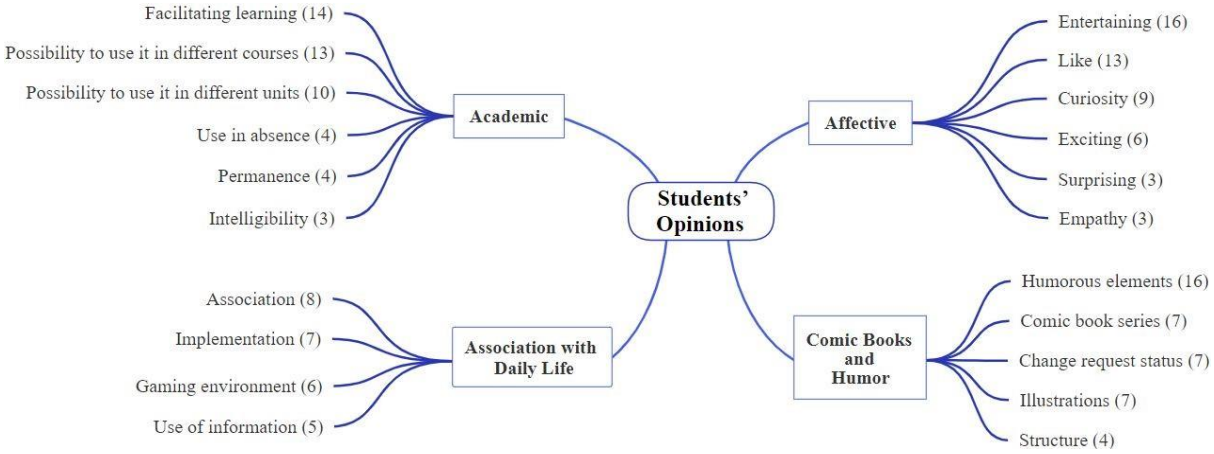
The findings obtained from the interviews conducted with the students and the course teacher, following the implementation of CBC Book in teaching, are presented under two separate headings.

Students' Views on Context-Based Comic Books

As a result of the analysis of the data obtained from the students, the opinions about the CBC Books and the implementation process were examined under the themes of "Academic," "Affective," "Association with Daily Life," and "Comic Books and Humor." The themes and sub-themes developed in line with the students' views on CBC Book and its implementation are presented in Figure 4.

Figure 4

Students' Views on CBC Book and Its Implementation



Theme "Academic"

The theme "academic" consists of sub-themes of Facilitating Learning, Possibility to use it in different courses, Possibility to use it in different units, Use in absence, Permanence, and intelligibility. The sub-theme of Facilitating Learning includes the codes of Sampling (f=6), Teaching the Subject (f=4) and Using Illustrations (f=4). Students stated that using comic books in the science lesson facilitated learning,

and thus they learned the related subject more easily. The students indicated the reason underlying this situation as that the information/knowledge presented in the comic book was chosen from the events they have constantly seen or encountered in their environment, detailed by associating with daily life and supported by illustrations. An exemplary student response regarding how the comic book facilitates learning is presented below.

> "The comic not only shows the information but also explains why it is so. In some books, for example, they have an adventurous car race; one wins, and the other loses. The character asks why he couldn't win. However, there is no mention of why he won or lost the race. But it is mentioned here, the reason why Ilgaz won is explained here, which I think is very good." (S18, Girl) (The name of the character in CBC Book is Ilgaz.)

The students were asked further questions about which other courses CBC Book could be used, why they mentioned those courses, the differences between the current textbook used for the preferred course and the comic book, and which features of the comic book they want to bring to the lessons in question. Social sciences (f=7), Turkish (f=4), and Mathematics (f=2) codes were derived in line with these questions, and these codes were then grouped under the "Possibility to use it in different courses" sub-theme. While all the students said that comic books could be used in social sciences courses, the majority of them stated that comic books could be used in Turkish and Mathematics lessons in addition to social sciences. The reason underlying this situation was indicated as the prevalence of text-based materials in the courses in question, that it would be more enjoyable, and they would comprehend more easily if these topics were taught with comics. The code "Social sciences" was found to be the most frequently recurring code under the sub-theme of "Possibility to use it in different courses.". An exemplary student response regarding the possibility of using the comic book in different courses is presented below.

> "… because it helps you to comprehend the Social sciences lesson better. We can learn about the historical events mentioned in the social sciences lesson. We can more easily understand the points that are difficult to understand in the social studies lesson." (S3, Girl)

The students were asked further questions about whether different units can be taught using comic books, which units they would like to be taught using comic books, and reasons for mentioning these units. All units (f=4), Living world (f=3), Matter, and Change of State (f=2), as well as Electrical Circuit Components (f=1) codes, were reached in line with these questions. These codes were then grouped under the "Possibility to use it in different units" sub-theme. While some of the students wanted comic books to be used in Living world, Matter and Change of State along with Electrical Circuit Components units, the majority of them stated that they wanted comic books to be used in all units. Students further stated that they had difficulty comprehending the subject when other textbooks or supplementary materials were used; however, they both understood the subject without any difficulty and also had fun when CBC Book was used. All units were found to be the most repeating code under the "Possibility to use it in different units" sub-theme. An exemplary student response regarding the possibility of using the comic book in different units is presented below.

> "Let comic books be used in any topic, any topic, any subject. This is so good!" (S15, Girl)

The students were then asked further questions about whether or not they were absent in the courses lectured using CBC Book, how they made up for missed classes, how they made up for non-science courses that they could not attend, and the

differences between reading the comic books and the books of other courses while making up the courses which they could not attend. The codes Health status (f=2) and Personal studying (f=2) were identified in relation to these questions and subsequently grouped under the sub-theme of "Use in absence." The students stated that they tried to make up for their deficiencies by reading the comic books for the science course and the books of the related course for the other courses on the days that they were absent. Students said that they effectively made up for the science lessons lectured on the days they were absent thanks to the comic books; however, there were subjects that remained miscomprehended in other courses. A student response regarding the "Use of the comic book in absence" is presented below.

> "I got sick. For this reason, there were days when I was absent from the class. I got very upset. I wondered which page we were on and what happened. I found out which page we were on by asking my friends. For example, I asked which topics were lectured in the social sciences lesson, I learned the pages. I pretended these pages to be given homework and read these pages from the book at home. I also read the comics. Ilgaz and Berk were talking among themselves. As they talked and as I read, they made me happy. When I read the comic book, I understood the subject better." (S15, Girl) (The name of the other character in the CBC Book is Berk.)

Permanence (f=3) and staying in mind as the student likes it (f=1) codes were grouped under the "Permanence" sub-theme. Among the students interviewed, there were some who stated that they had read the comic book before. However, they did not forget the subject of the comic book, and it permanently remained in their minds despite the reasonable time that passed over. When students were asked whether they remembered other books that they had read throughout the same period, they stated that they clearly remembered the comic book and the subject it dealt with, while they could not exactly remember other books. A student response regarding the fact that "The content of the comic book has a more permanent place in the minds of the students compared to other books" is presented below.

> "I used to read comics while in second grade when I was very young. It was about history. It was about the Çanakkale Victory. The subject was our martyrs there. Some cities were renamed as (Glorious) Urfa and (Ghazi) Antep. I also read those books. I had read comic books about these topics but never read one about the course like this… I don't remember exactly the other books I read back then, but I remember the comics because I loved them. I hardly forget the things I love. They are on my mind. "(S17, Boy)

Detailed Explanation (f=2) and Concretization of the subject (f=1) codes were grouped under the "Intelligibility" sub-theme. Under these codes, the students indicated their ability to understand the comic book and the subject in question. The students indicated that they may have difficulty in understanding the expressions referred to in the textbooks or different course materials when they read them, but this was not the case concerning the comic books and that they clearly understood the subject without any difficulty from the first reading. Supporting the expressions in the comic books with illustrations helped the subject to be visualized in students' minds and made it more understandable. Detailed Explanation was found to be the most repeating code under the "Intelligibility" sub-theme. A student response regarding these views is presented below.

> "When I read the textbooks, I had a hard time understanding, subjects are more explicitly explained in the comics. The comic books also explain things, moreover, they are illustrated. These illustrations were not in the textbooks. I read the textbooks 2-3 times, over and over, to

understand, but this is not the case in comics. I understand comics immediately when I read them." (S3, Girl)

Theme "Affective"

Theme "Affective" consists of the sub-themes of Entertaining, Like, Curiosity, Exciting, Surprising, and Empathy. Amusing (f=12), Laughter (f=2), and Comic (f=2) codes were grouped under the "Entertaining" sub-theme. Students expressed that they found the dialogues between the characters and the events that took place in the story very entertaining, and that it was enjoyable to read the CBC Book, although they could not fully understand the correlation between the comic book and the course when they first saw it. When students were asked why a comic book seemed entertaining to them, they stated that the illustrations and speech bubbles made them feel like they were in the narrated place and that the humorous elements made the comic book entertaining. They further explained that this made them learn the subject better. Amusing was found to be the most repeating code under the "Entertaining" sub-theme. An exemplary student response regarding the fact that "The students found the comic book entertaining" is presented below.

"... I was a little excited at the beginning that I was going to read the comic book. Then I found it entertaining when I read it; it was really nice. The fact that it's entertaining makes it even easier to learn." (S9, Boy)

Being happy (f=5), Enjoying (f=4), Finding beautiful (f=3), and Interesting (f=1) codes were grouped under the "Like" sub-theme. All of the students interviewed said that they liked the CBC Book. The students expressed that they liked the comic book on the basis of reasons such as its narrative style, content, script, being supported with illustrations, the topics concerned, humorous elements, and the comprehensibility of the information presented. An exemplary student response regarding the statement "The students liked the comic book" is presented below.

"I hadn't read comic books before... I read this, and I liked it a lot. I couldn't sufficiently understand other books. There are more understandable things in this book, that's why I liked it." (S3, Girl)

Being curious about the content (f=6) and Wondering about the rest of the adventure (f=3) codes were grouped under the "Curiosity" sub-theme. The students said that they were curious to see the contents from the first moment they got hold of the comic book, that the adventures and illustrations attracted their attention when they started to read it, they were curious about what would happen on the next page. Also, that is why they wanted to finish the book as soon as possible. The students who participated in the research stated that they finished the comic book quickly because they were curious about the ending. Being curious about the content was found to be the most repeating code under the "Curiosity" sub-theme. An exemplary student response concerning the Theme "Curiosity" is presented below.

"When our teacher gave me the comic book, I was curious about the content and the ending. I thought about what kind of adventures there are. We were going to learn about the measurement of force and friction, but I wondered what these issues had to do with the comic book; however, I realized the correlation when I read it later on." (S17, Boy)

Getting excited while reading (f=4) and Adventures (f=2) codes were grouped under the "Exciting" sub-theme. The answers concerning the students' excitement during the implementation of the CBC Book were presented based on these codes. Students expressed their excitement about the adventures in the script from their initial

encounter with the comic book and throughout its implementation and they also expressed a desire to quickly finish reading the comic book. Getting excited while reading was found to be the most repeating code under the "Exciting" sub-theme. An exemplary student response regarding the fact that "The students found the comic book Exciting" is presented below.

> "I was a little excited that I was going to read comic books for the first time. I felt different as if I had seen something new for the first time." (S6, Girl)

Failure to set the correlation (f=2) and Encountering the comic book for the first time (f=1) codes were grouped under the "Surprising" sub-theme. The students said that they were initially surprised when they first saw the comic book and did not understand its connection to the science course. However, their surprise diminished once they started reading it. An exemplary student response concerning "the students who were surprised when they saw the comic book" is presented below.

> "When I first saw it, I was surprised that we were going to read comic books for the first time; after reading it, I felt happy." (S1, Boy)

The sub-theme "Empathy" consisted of thinking similarly with the character (f=2) and daydreaming (f=1) codes. Students expressed that during the lesson taught using the comic book, they imagined themselves in the shoes of the characters and felt as if they were speaking the dialogues in the speech bubbles directly to someone in front of them. They further expressed that they internalized the subject while the lesson was taught, and thus, they were not bored. An exemplary student response concerning Sub-theme "Empathy" is presented below.

> "I had different dreams. I wanted to read the comic book. I read the comic book, and I put myself in the place of the characters while reading it. I felt like I was talking to them in front of them. That caused me to better understand the subject." (S15, Girl)

Theme "Association with Daily Life"

The sub-themes of this theme are Association, Implementation, Gaming environment, and the Use of information. Problems encountered (f=3), Friendship environment (f=3), and Family environment (f=2) codes were grouped under the "Association" sub-theme. Students said that they used the information they got from the comic book to explain the reason for an incident that happened during a conversation while chatting with their friends or family or while solving a problem they encountered in their close environment. An exemplary student response concerning the Theme "Association" is presented below.

> "When we were in the village, the tractor once got stuck in the mud when the soil softened in the field. There was a similar incident in the comic book where the truck broke down on the road. Then my uncles saved the tractor." (S6, Girl)

Testing the knowledge acquired (f=3), Material construction (f=2), and Measurement (f=2) codes were grouped under the "Implementation" sub-theme. Students said that the topics covered in the comic book during the lessons taught using CBC Book included situations that they have encountered or may encounter in their daily lives. They further stated that they converted the knowledge acquired from the comic book into practice by using the materials or tools they found in their close environment. In this particular context, the students created a dynamometer using the available materials and conducted measurements with the dynamometer. They did this during visits to the village, as well as by driving their toy cars or bicycles in various

environments, aiming to observe and compare the effects of friction force. In this way, they also had the opportunity to observe the different applications of the information they acquired at school. A student response concerning "The activities performed by the students within the scope of sub-theme Implementation" is presented below.

> "My brother and I performed a similar car race described in the comic book. I drove my car on the carpet, and my brother drove on the tile; my brother beat me. My car kept getting stuck on the carpet while my brother's car went faster on the tile." (S3, Girl)

The students were further asked whether they could associate the knowledge they acquired at school using the CBC Book with their daily lives. The codes Cycling (f=3), Playing basketball (f=2), and Driving a Toy Car (f=1) were generated in response to these questions, and they were subsequently grouped under the sub-theme of "Gaming environment". Students stated that they were able to associate an event that took place in their gaming environment and the knowledge they acquired in the science course using the CBC Book. They further indicated that they were able to use the information they acquired in the lesson to solve the problem situation similar to or different from the events encountered in the comic book scenario or explain the reason for it. An exemplary student response related to the "Gaming environment" sub-theme is provided below.

> "I learned about the friction force in class. I stepped on the brake while riding a bike, and the bike slowed down and stopped. I said that this situation is caused by the friction force." (S1, Boy)

Equivalent in daily life (f=4) and Concrete examples (f=1) codes were grouped under the "Use of information" sub-theme. The students reported that CBC Book, supported by dialogues and illustrations, provided them the opportunity to observe the equivalents of the acquired subjects and concepts in daily life. They further stated that they had the opportunity to learn the working principle of the dynamometer while the characters in the comic book were picking apples in the village garden, the use of thin and thick springs in the dynamometer when the characters disrupted the elasticity of the dynamometer spring in the schoolyard and to observe all of these topics with examples of everyday life. The illustrations in the CBC Book enabled the related topics to become more concrete in students' minds. A student response concerning the "Use of information" sub-theme is presented below.

> "For example, you are going to buy a dress, and you need to compare the money in your pocket with the money required for the dress in the math class. This situation can be described in a comic book. It might be a little different, but it would be entertaining." (S6, Girl)

Comic Books and Theme "Humor"

Humorous elements, Comic Book Series, Change request status, Illustrations, and Structure sub-themes are grouped under the theme "Humor" The characters' saying bandy words to each other (f=9) and the Funny episodes (f=7) codes were grouped under the "Humorous Elements" sub-theme. Students expressed that they found learning a particular subject much more enjoyable when the characters were engaging in playful banter with their siblings, competing in races, exchanging jokes with school friends, and in episodes where humor played a prominent role. The students described the comic books as both entertaining and informative based on the fact that the scenarios covered were supported by illustrations and included humorous elements. An

exemplary student response related to the "Humorous Elements" sub-theme is presented below.

> "I laughed aloud when two brothers were having a conversation and argument; this made me feel happy. Towards the end, they were going to the amusement park. They were having an argument while picking apples in the village, they were arguing at school, and it was very funny when they were pulling ropes with girls." (S15, Girl)

Awaiting upcoming episodes (f=5) and search for similar comic books (f=2) codes were grouped under the "Comic Book Series" sub-theme. The students stated that they liked the structure of the comic books, that they were entertained when they read it, and that they better understood the subject intended to be taught; so, they wanted to read more. They further indicated that they searched for similar comic books, and they found examples of comic books that were not related to the lessons, but they had difficulty finding comics that were directly related to their lessons. The students interviewed expressed that they would be happy to have new comic books which covered different course topics. Some of the students expressed a desire to have comic books featuring the same characters but with adventures related to different subjects taught in their courses. Awaiting upcoming episodes was found to be the most repeating code under the "Comic Book Series" sub-theme. An exemplary student response concerning these issues is presented below.

> "For example, Ilgaz and Berk may visit other places in the books prepared for other courses. They may visit China and meet other friends. It would be like a textbook set. We love the adventures of Ilgaz and Berk. They may have different adventures in mathematics, something else in social studies." (S18, Girl)

Finding sufficient (f=4) and Coloring request (f=3) codes were grouped under the "Change request status" sub-theme. The students were further asked which changes they would like to make to the comic books. Some of the students interviewed stated that the comic books could be colorful, while the majority said that they were already beautiful as such and there was no need for any change. The students stated that there were no sections in the comic book that bored them or that they wanted to remove. These opinions of the students were included in the "Change request status" sub-theme, and an exemplary student response related to this issue is presented below.

> "I don't want to change any section. It's already entertaining as it is. This is fine." (S9, Boy)

Further illustrations (f=5) and text-illustration balance (f=2) codes were grouped under the "Illustrations" sub-theme. The students stated that they were positively influenced by the illustrations and the humorous elements supporting the subjects in the comic book. They further expressed that the text-dominant content of the textbooks was boring and suggested comic books be used in courses other than science. Further illustrations were found to be the most repeating code under the "Illustrations" sub-theme. These opinions of the students were included in the "Illustrations" sub-theme, and an exemplary student response concerning this issue is provided below.

> "I really loved the comic books because of the picture content. I like the illustrations. Text-heavy books seem a little boring." (S1, Boy)

Context (f=2) and Style (f=2) were the two codes grouped under the "Structure" sub-theme. Students stated that they were very impressed and excited by the illustrations and the context when they read the comic book. As the underlying reason for this situation, they pointed out that the illustrations included in the structure of the comic book are quite effective in complementing the information presented in the

writing. Furthermore, the presentation of the information aimed to be taught within the scope of the science courses in connection with daily life and accompanied by adventures turned the comic book into a course material different than the textbooks that students were used to. This fact was included in the "Structure" sub-theme, and an exemplary student response concerning this issue is presented below.

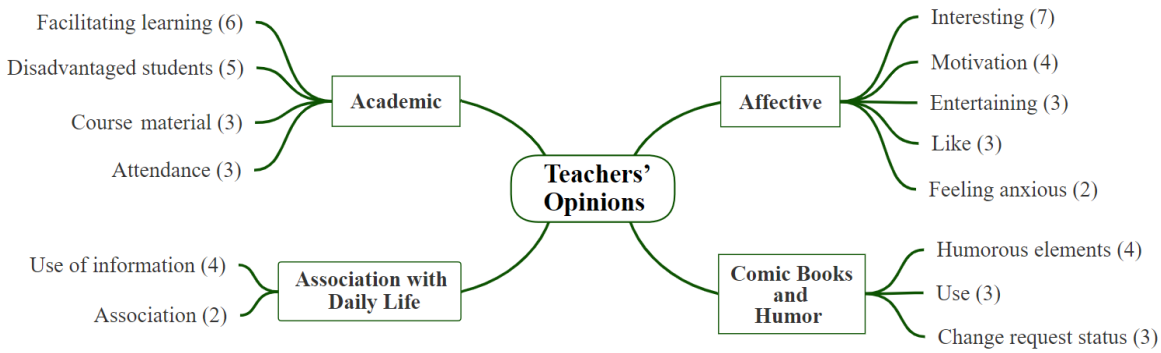
> "I was getting excited while reading the comic book. The comic book sounded very exciting because of the script, the illustrations, and what it was telling. It was quite different and beautiful compared to our own textbook." (S1, Boy)

Science Teachers' Views on Context-Based Comic Books

As a result of the analysis of the data obtained from the implementing course teacher, the opinions about the CBC Books and the implementation process were examined under the themes of "Academic," "Affective," "Association with Daily Life," and "Comic Books and Humor." The classifications related to the themes and sub-themes derived in accordance with the opinions of the implementing course teacher are presented in Figure 5.

Figure 5

Course Teacher's Views on CBC Book and Its Implementation



Theme "Academic"

Theme "Academic" comprises Facilitating learning, Disadvantaged students, Course material, and Attendance sub-themes. The course teacher was asked questions concerning the effects of teaching lessons with CBC Book on students' learning. The use of illustrations and texts (f=3), Adventures (f=2), and Entertaining teaching (f=1) codes were derived based on these questions, and these codes were then grouped under the "Facilitating Learning" sub-theme. The course teacher said that the adventures in the comic book, the humorous elements included in its structure, and the topics and concepts discussed are supported by illustrations which allow students to better learn the related topic. An exemplary response concerning the "Facilitating Learning" sub-theme is provided below.

> "... the events, topics, and concepts decoded in the comic book were motivating; the students learned better when these came together. Sometimes students get tired of reading a long text, they leave it aside without finishing, but the student reads a comic book to the end."

Implementing course teacher was further asked whether there were disadvantaged students in the class and the status of these students in the courses taught using the CBC Book. Reading difficulties (f=3) and Foreign national students (f=2)

codes were reached based on these questions, and these codes were grouped under the "Disadvantaged students" sub-theme. Implementing course teacher stated that there was a student with literacy difficulties in the classroom and a foreign national student who could not fully understand Turkish. The teacher further indicated that teaching the courses using comic books improved the participation of disadvantaged students in the courses. The underlying reason for this situation was explained as the fact that these students could make inferences about the subject under consideration as the texts were supported by illustrations even though they could not fully comprehend the statements contained in the texts. The teacher's response concerning the "Disadvantaged students" sub-theme is presented below.

> "... students with literacy problems and most foreign national students may already have problems understanding Turkish. How far can you reach out to a student by trying to teach science to a student who already doesn't know Turkish well enough. For example, I have a student "H" who has problems in reading and writing; this is the first time I've seen him participating so much in class. Illustrations also have an instructive effect. The student is trying to understand what is happening by following the illustrations even if s/he does not know how to read and write. This indicates that the student can learn better when supported by illustrations. We also have foreign national students, and we have difficulty teaching subjects because, as I said before, these students do not sufficiently know the language. They were following the lesson in spite of these disadvantages. The student makes the inference that this happened here, this happened there by just looking at the illustrations."

Details (f=1), Presentation of the information (f=1), and Interesting (f=1) codes were grouped under the "Course Material" sub-theme. The course teacher provided reasons why the comic book could be utilized as a course material, such as offering additional details not covered in the textbook that should be highlighted by the instructor, accompanied by examples from everyday life relevant to the discussed topic. The teacher also noted that the illustrated content of the comic book enhances the learning experience. In addition, by the end of the implementation, the teacher conveyed that the students rather enjoyed the comic book as they expressed a desire for future units and courses to be taught using this method and showed interest in having textbooks prepared in comic book format. An exemplary teacher's response concerning the "Course Material" sub-theme is presented below.

> "When compared with the textbook, we can even say that the comic book alone is sufficient enough. I even think that the comic book is somewhat more advantageous than the textbook. For example, we teach the textbook of the 5th grade in other classes, and the student may have difficulty in comprehending the relevant concepts covered in the topic. The comic book provides better access to the prepared contents compared to the textbook. However, when the textbook is used, the student may have difficulty deriving the concepts. I think that the exam group students will be more successful in case CBC Book method is implemented in the 8th grade. I think it will improve academic success."

Indifferent students (f=2) and Attracting interest to the course (f=1) codes were grouped under the "Attendance" sub-theme. Implementing course teacher stated that CBC Book draws the attention of students to the lesson and that even the students with a poor interest in previous lessons could adapt and actively participate in the lesson taught. They further said that foreign national students and students with reading difficulties actively followed the course, and that CBC Book had a positive effect on their participation in the course. An exemplary teacher's response concerning the "Attendance" sub-theme is presented below.

> "... there are necessarily students in every class who have little to do with the lesson; even students who had little interest in the lesson taught before tried to participate in the lessons taught using the comic books."

Theme "Affective"

The sub-themes of Interesting, Motivation, Entertaining, Like and Feeling anxious are grouped under the current theme. Interesting content (f=4), interesting illustration (f=2), and interesting material (f=1) codes were grouped under the "Interesting" sub-theme. The course teacher stated that he had previously read comics at different levels that were unrelated to lessons. He found the comic books interesting but had never thought that they could be used in teaching. The teacher said that the comic books attracted the students' interest in the lesson due to their features, such as structure, content, illustrations, and humorous elements. He further said that he made extra effort to attract the children's interest in the lesson in other classes; however, there was no need for such an effort thanks to the use of comics in the implementation class. It was emphasized that comic books served as an effective course material in capturing students' interest, particularly when teaching subjects and concepts that students typically showed indifference towards. An exemplary teacher's response concerning the "Interesting" sub-theme is presented below.

> "... the use of the comic book in the lesson provided great convenience. It requires additional effort to draw the students' attraction to the lesson in other classes. However, in the present case, all the children raise their fingers as soon as we start the lesson. In the implementation class, we can draw the students' attention directly into the subject without making any extra effort, but in the other classes, it is necessary to give extra examples to the students."

The motivation sub-theme consists of a combination of Motivating structure (f=2) and Motivating script (f=2) codes. The course teacher stated that factors such as the way the courses taught with comic books dealt with the subject, the content and structure of the CBC Book, and the inclusion of humorous elements motivated the students. The teacher's response concerning the "Motivation" sub-theme is presented below.

> "... the most difficult and most essential part is to draw the student's interest to the lesson. This situation takes up a significant part of our time in a standard course flow. We are just trying to draw the student's interest to the subject in the first 10-15 minutes. But when comic books are concerned, the examples, drawings, illustrations, and visuals combined with the text directly motivate the child. And that made it easy for us. Having attracted the child's attention to the lesson and providing high motivation yielded positive results. When we give the information/knowledge to the student, accompanied by life stories and adventures quoted from everyday life, and when we finalize the teaching activity with an assessment at the end, I really think that the student learns the subject very well."

Amusing (f=2) and Laughter (f=1) codes were grouped under the "Entertaining" sub-theme. The course teacher conveyed that students found the CBC Books entertaining due to factors such as humorous elements included in the script, illustrations supporting the narrated topic, and associations with everyday life. Furthermore, the teacher stated that students found something of themselves in the comic books, that they exhibited positive reactions during and at the end of the implementation, and that they wanted the implementation to be repeated with comics with similar content because they enjoyed the experience. The teacher's response concerning the "Entertaining" sub-theme is presented below.

> "I think that the comic book attracted the attention of students in the lessons not only because of its structure but also due to its content, so it was really entertaining to teach a lesson with a comic book."

Happiness (f=2) and Satisfaction (f=1) codes were grouped under the "Like" sub-theme. The course teacher said that students liked the CBC Books and that they were happy to use them in classes. The students also stated that they wanted other units in the science course to be taught using comic books. The teacher's response related to the "Like" sub-theme is provided below.

> "The students liked the comic book very much and were always happy throughout the implementation. They told us that they wished other units to be taught using the comic books method. They also suggested the textbooks be prepared similarly. The stories, illustrations, and quotes from daily life in the comic books better motivated the students in the lesson; the students almost found themselves in these elements. I've always had positive feedback."

Anxiety (f=1) and Use in teaching (f=1) codes were grouped under the sub-theme of "Feeling anxious," and the opinions of the implementing course teacher presented before and after the lessons lectured using the CBC Book were included herein. The course teacher had initial thoughts that teaching with CBC Books could be entertaining but also expressed concerns about difficulties students might face in learning the subject. The teacher further stated that he was curious about the reactions from the students, but the positive reactions from the students dispersed the concerns about the learning performance of the subject. An exemplary response concerning the "Feeling anxious" sub-theme is presented below.

> "Before the implementation, I had concerns about how the lessons would be, whether it would be just entertaining or whether we could teach the subject effectively. I was really wondering what kind of result would turn out in the end, but when I started the implementation, I realized how beautiful it was; my worries disappeared. I noticed that students are learning the subject better."

Theme "Association with Daily Life"

The sub-themes under this theme are the use of information and association. The learning outcome of the information (f=3) and Problems encountered (f=1) codes were grouped under the "Use of information" sub-theme. Implementing course teacher indicated that the association of events taking place in everyday life with the topic under consideration and presenting them to the students supported by speech bubbles and illustrations within a scenario has given the students the opportunity to see the correspondence and usage areas of the information/knowledge acquired in their daily lives. The teacher further stated that the students' interest in the course was high both because of the humorous elements and the opportunity to come across the correspondence and usage areas of the information/knowledge acquired in their daily lives. An exemplary response concerning the "Use of information" sub-theme is presented below.

> "... when, under normal circumstances, we give a certain information/knowledge to a student, they have always questioned what this information would be useful for; now that they have got the answer to that in the comic book. I think that's the main benefit of the comic book. For this reason, the student was much more motivated and learned better."

Association with daily life (f=1) and Association with the immediate environment (f=1) codes were grouped under the "Association" sub-theme. Implementing course teacher stated that a student finds the opportunity to see the equivalent of the knowledge acquired at school when he goes outside the classroom as

the examples included in the comic book are taken directly from everyday life. It was further reported that students had realized the equivalent of the information/knowledge they have acquired in the lessons taught with comic books in the environments they visited outside the school and that they have shared this experience in the classroom by establishing the necessary associations. An exemplary teacher's response concerning the "Association" sub-theme is presented below.

> "... as the samples taken from daily life are placed inside the comic book, the student knows that they may encounter such examples when they go outside. One of our students shared the experiences at home with us in the classroom. Another student mentioned putting on the brake while riding the bike, slipping over, and falling and, as a result of this incident, immediately remembering the topic covered in the lesson. He even said that the friction force was relatively less in the situation he experienced, and he gave an example. So, the examples included in this comic book make positive contributions to the transfer of knowledge."

Comic Books and Theme "Humor"

The current theme includes humorous elements, use, and change request status sub-themes. Contribution of funny events (f=2), Attraction of funny events (f=1), and Entertainment of funny events (f=1) codes were grouped under the "Humorous Elements" sub-theme. The implementing course teacher stated that the students thoroughly enjoyed the sections of the comic books where the humorous elements were prominent during the reading process. It was further stated that the inclusion of these sections in the comic book had attracted the students' attention to the lesson, and thus they better understood the subject. An exemplary teacher's response concerning the "Humorous Elements" sub-theme is presented below.

> "... Students particularly had fun in the episodes of the journey to the village at the beginning of the story, the disputes of the siblings, the episode of the car race, and the section where the siblings broke down the dynamometer. We've focused on these issues; we've received positive feedback, and the children really liked it. Although they were given the opportunity to make a dynamometer from scratch, the students were more interested in the subject when covered in the comic book in the form of an adventure."

Contribution of the illustrations (f=2) and the Use in other units (f=1) codes were grouped under the "Use" sub-theme. The implementing course teacher said that the drawings in the comic book attracted the attention of the students, and the illustrations provided a better understanding of the subject. Furthermore, it was reported that there were no difficulties encountered in using the comic books and that similar comics could be easily employed for other units. An exemplary teacher's response regarding the "Use of the Comic Book" sub-theme is provided below.

> "... thanks to the comic book, students have more easily adapted to the lesson. Not only the children found something of themselves, but also the illustrations have quite attracted attention. I also had concerns about the outcome before the implementation, but then I saw how successful it was. I noticed that children are learning the subject better; so, I think that new comic books suitable for other units, if prepared, can also be used in those units."

Implementing course teacher was asked whether there was any amendment that he wanted to make to the CBC Book used during the lesson, but the answer revealed that the current CBC Book used was sufficient and there was no need for any amendments. Applicable (f=2) and Sufficient (f=1) codes were generated based on these answers, and these codes were grouped under the "Change request status" sub-theme. It was mentioned during the interviews that some of the students expressed a desire for the comic book to be colored. However, when asked about the potential

impact of coloring the comic book during the implementation, it was stated that no significant differences were expected. Therefore, it was concluded that the comic book could remain in its current form. An exemplary teacher's response concerning the "Change request status" sub-theme is presented below.

> "... maybe it will be different if the comic is colored, but the black and white version that we currently use also has a different taste. I don't think there's any need for a change."

Discussion and Conclusion

After the teaching implementation was carried out using the CBC Book, interviews were held with the implementing course teacher and seven students who participated in the implementation. As a result, the opinions of the implementing course teacher and the students were grouped under four main themes: Academic, Affective, Association with daily life, and Comic Books and Humor.

Under the theme "Academic," the academic dimensions of the CBC Book from the viewpoint of students and teachers were examined in depth. In this regard, issues such as the comprehensibility of the CBC Book for students, its impact on learning, its usability in different units and courses, and the possibilities of personal follow-up for absent students were examined. The issues examined from the perspective of the implementing course teacher included the students' participation in the course, its impact on their learning performance, its usability as course material, and its usability for disadvantaged students. Students stated that they sometimes faced difficulty in understanding the expressions in the textbooks or different course materials when they read them, requiring them to read them multiple times. However, the presentation of the texts described in the CBC Book, as supported by illustrations, provided an elaboration of the topic under consideration, and in this way, they could understand the related topic more easily without experiencing difficulties. Owing to the use of comic books in teaching, the topic to be narrated is illustrated based on real life, making the topics and concepts discussed more comprehensible by students (Affeldt et al., 2018). That is, the use of comics allows students to realize how to relate the topic to real life and experience the moments to be vocalized as 'A-ha!' (e.g., Kurnaz & Çalık, 2008; Metcalf & Tinker, 2004).

Presenting text and illustrations to students using the CBC Book in a way that complements each other in harmony ensured the topics and concepts covered were more comprehensible by students. Implementing course teacher also expressed an opinion in support of this situation. Accordingly, he said that the adventures in the comic book, the humorous elements included in its structure, and the topics and concepts discussed were supported by illustrations which allowed students to better learn the related topic. Students understand better if a text captures their interest (Schiefele et al., 2012). It is known that the use of comic books in lessons draws the attention of students with low interest in the lesson (Cheesman, 2006). In addition, including examples and contexts related to daily life in the lessons also attract interest in the lesson (Ültay, 2014). For the purpose of the current study, it was also determined that the CBC Book attracts the attention of students allowing them to adapt to the lesson. Even the students with low interest were found to participate in the lesson taught using the CBC Book.

Implementing course teacher stated that there was a student with literacy difficulties in the classroom and a foreign national student who could not fully

understand Turkish. The comic book comprises a mixture of illustrations and texts in its structure and addresses its reader using a different language (Groensteen, 2007). In light of these considerations, it was observed, as stated by the implementing course teacher within the scope of the current research, that teaching the lessons using comic books improved the participation of disadvantaged students in the lessons, and students understood the topics better compared to the lessons taught without using any comic books. The fact that comic books are interesting and intriguing even for illiterate children (Afrilyasanti & Basthomi, 2011; Yüzbaşıoğlu & Kurnaz, 2022a) explains the teaching implementation using the CBC Book with foreign national students who have difficulties in reading and writing along with the problems of establishing meaning in Turkish. The inclusion of interesting illustrations in the CBC Book, as reported by the students interviewed in the current research, sparked curiosity and promoted active engagement in the lessons. Similarly, Rota and Izquierdo (2003) stated that the comic book reader is active in the learning process. The readers are further reported to make efforts to establish the relationship between the illustrations and the text within the process of being active in this lesson. In the lessons taught with the CBC Book, disadvantaged students were found to be able to make inferences about the subject being discussed, although they could not fully understand the expressions in the texts because the texts were supported by illustrations.

Among the students interviewed, there were some who stated that they had read the comic book before, and despite the passage of time, they retained a lasting memory of the subject of the comic book. Students were found to have difficulty remembering the subject and content of different books they read, whereas they clearly remembered the comic book and its topic. Comic books contribute to the comprehension of the presented information by students and provide an opportunity for permanent learning (İlhan, 2016; Kurt, 2019; Mutlu, 2019). The fact that students are more likely to remember the comic books that they had read at a younger age and their contents compared to other books supports this finding.

The students stated that they personally tried to make up for their deficiencies on the days they were absent and when they could not go to school by reading the comic books for the science course and the textbooks of the related course for the other courses. They further said that they effectively made up for the science lessons lectured on the days they were absent thanks to the comic books. However, there were subjects that remained misunderstood in other courses. There were findings in the literature supporting this suggestion, indicating that students needed supplementary course materials to better understand the subject after the lessons taught by traditional methods adhering to the textbook, whereas they did not have such a need after the courses taught using comic books (Çiçek Sentürk, 2020). Individuals may overlook the information provided while reading texts that do not draw their interest or are not motivating, and they try to finish the text quickly. The fact that other textbooks published at this age remain insufficient to attract the attention of students may make it difficult for students to make sense of some sections when they read them individually. The use of comics in the teaching environment, compared to traditional practices, offers the opportunity to enrich learning experiences and encourages the active participation of students in the teaching process (Affeldt et al., 2018; Lazzarich, 2013). Based on the statements of the students saying that they understand the subjects more easily when they read the CBC

Book individually at home on the days when they are absent compared to other textbooks, it can be suggested that comic books can be used as an effective teaching tool when students personally assume their own learning responsibilities.

Students stated that all the units taught in the science course could be lectured using similar comic books. In relation to this, the first priority preferences of the students were the units entitled Matter and Change of State, the World of Living Creatures, and the Electrical Circuit Components. When the students were further asked which other courses they would like to use the CBC Books, they all preferred the social sciences course. Some of the students said that comic books could be used in Turkish and Mathematics lessons in addition to social sciences. The reasons students expressed for preferring these courses were the predominance of text-based lessons and the requirement to take notes. Therefore, students stated that using comic books in the lessons would make them more enjoyable and improve their understanding of the topics. Textbooks alone may be insufficient in attracting and maintaining students' interest in the course, as most of their content is written texts. Incorporating comic books, in which the information/knowledge presented as text is supported by illustrations, will be essential to eliminate this situation (Ünal, 2018). The fact that students want to use the CBC Books in other units and courses also supports this proposition. Implementing course teacher suggested comic books to be used as a course material on the grounds that a comic book offers details that are not included in the textbook and that should particularly be mentioned by the instructor along with many examples taken from everyday life in the narration of the relevant topic and that the narrated topics are supported by illustrations. The literature review revealed that the use of the comic book as course material contributes positively to students' academic success (Topkaya, 2014), encourages class participation (Kurt, 2019), and contributes to the comprehension of the information presented by the students and permanent learning (İlhan, 2016; Sarıbıyık, 2018). Based on these considerations, it is possible to conclude that the CBC Books may be used as effective course materials on the grounds that it makes the subject matter entertaining and understandable, facilitates learning, provides an opportunity for a permanent learning experience and individual learning, encourages class participation, and supports the learning processes of students with literacy and language problems. Studies also revealed that there were similar research findings supporting this proposition where courses such as Citizenship and Democracy (Topkaya, 2014), Social Sciences (İlhan, 2016; Ünal, 2018), and Physics (Orçan, 2013) were taught using comic books as teaching materials.

Theme "Affective" was derived based on the opinions of the implementing course teacher and students about the CBC Books. The students stated that they were excited at the moment they saw the comic book for the first time, that they could not fully understand its relevance to the lesson, and that they were curious about its content. They further said that they found the dialogues between the characters and the events that took place within the scope of the story very entertaining, and it was enjoyable to read them. The use of comic books encourages students to read (Wood, 2015). A similar result was obtained in the current research, and the students said that they liked the illustrations and the script of the comic book, expressed that reading comic books made them happy and that they finished the CBC Books quickly because they were curious about the ending. The reactions of the characters featured in the comic book to the

events and situations related to daily life are effective in the comic book reader's association with the character and in making sense of the scenario (Alsaç, 1994; Cantek, 2014; Kireççi, 2008; Tuncer, 1993). Appropriate context selection enables students to relate the concepts to their own lives (Ültay, 2014). For the purpose of the current research, the students interviewed stated that the illustrations and speech balloons in the CBC Book made them feel like they were in the place where the story was narrated, allowed them to put themselves in the shoes of the characters and dream and to feel like they were saying the expressions in the speech balloons to someone who was in front of them. They further expressed that they internalized the subject while the lesson was taught, and thus, they were not bored. The inclusion of comic books in the lessons makes learning interesting for students and ensures them to be happy and eager for the lesson (Orçan, 2013; Tatalovic, 2009). In fact, it was found that using the CBC Book in the corresponding unit, along with the inclusion of humorous elements in the script, led to enjoyable learning experiences for the students, making them feel happy.

Implementing course teacher stated that he had previously read comics at different levels that were unrelated to lessons. He found the comic books interesting but had never thought that they could be used in teaching. The teacher further said that he estimated teaching with CBC Books might be entertaining, but he was also concerned about whether the students would have difficulties learning the subject. The reactions of the students worried him/her before the implementation; however, the positive reactions received from the students dispersed the concerns about the learning performance of the subject. The use of CBC Books in lessons was determined to be attracting the attention of students as well as to be entertaining and motivating towards the lesson due to factors such as the humorous elements included in the scenario along with the fact that the topic being narrated is supported by illustrations and associated with everyday life. There are studies in the literature that support this situation, stating that the use of comics in lessons improves the interest in the lesson, provides motivation, and contributes to learning new information (Çiçek Şentürk, 2020). Comic books are used in science lessons because they include interesting stories (Spiegel et al., 2013) and make the lesson more entertaining (Olson, 2008). The interviews held enabled us to conclude that the students wanted similar new implementations as they found something of themselves in the comics and had fun. İlhan (2016), who reached a similar conclusion, found that students who studied using comic books as course materials for the first time wanted to use them in their other courses as well.

The issues analyzed within the context of the theme "Association with Daily Life" from the students' point of view were the association of the information included in the CBC Book with everyday life, the ability to apply the acquired information into practice, and the use of the acquired knowledge. The issues analyzed from the implementing course teacher's point of view were the effectiveness of the teaching implementation using the CBC Book in helping students recognize the practical application of acquired information/knowledge in their learning environments and connecting them to real-life situations or events was assessed. The course teacher indicated that the association of events taking place in everyday life with the topic under consideration and presenting them to the students supported by speech bubbles and illustrations within a scenario had given the students the opportunity to see the correspondence and usage areas of the information/knowledge acquired in their daily

lives. The teacher further stated that the students' interest in the course was really high both because of the humorous elements and the opportunity to come across the correspondence and usage areas of the information/knowledge acquired in their daily lives. Hırça (2012) concluded that the topics covered in the lessons become more comprehensible for students when explained using examples from everyday life and that students develop a positive attitude towards the lesson. This finding supports the opinion of the implementing course teacher stating that the students' interest in the lessons lectured using the CBC Book is high. Furthermore, the students expressed similar opinions with the implementing course teacher and stated that the topics covered in the comic book during the lessons lectured with CBC Book consisted of situations that they had encountered or may encounter in their daily lives. The examples provided related to daily life are more easily understood by individuals (Rose, 2012; Taşkın & Moğol, 2017). Accordingly, it was found that students did not have any difficulty understanding the information included in the CBC Book and thought that this information was quite easy to understand. Students said that they could use the information/knowledge acquired in the lessons with the CBC Book to explain the reason for an incident that happened while chatting with their friends or family or while solving a problem they encountered in their close environment. The curriculum of the science course requires the students to use the knowledge and skills acquired in the course to solve everyday life problems (MoNE, 2018). In this regard, the students were found to be able to use the information acquired in the lesson to solve the problem situation similar to or different from the events encountered in the comic book scenario or explain the reason for it. Based on this finding, it is possible to argue that the courses taught using the CBC Book contribute to the realization of the specific goals defined in the curriculum.

The students reported that CBC Book, supported by dialogues and illustrations, provided them the opportunity to observe the equivalents of the acquired subjects and concepts in daily life. Canlas (2021) suggested that contexts should not be limited to the subject that students learned and that different contexts should also be used. Diversifying the contexts related to a certain concept will also prepare individuals for different problem situations. The use of contexts that are not relevant to students' daily lives can hinder their understanding (Bozdemir Yüzbaşıoğlu et al., 2020; Mustafaoğlu, 2019). The events presented in the CBC Book scenario were prepared by taking into account the possible environmental conditions in which students have been or may be present. Accordingly, the feedback received from the students and the course teacher revealed that the contexts in the structure of the comic book were clearly understood. Students stated that they had the opportunity to learn the working principle of the dynamometer while the characters in the comic book were picking apples in the village garden, the use of thin and thick springs in the dynamometer when the characters disrupted the elasticity of the dynamometer spring in the schoolyard and to observe all of these topics with examples of everyday life. The illustrations in the CBC Book enabled the related topics to become more concrete in the minds of the students. Previous studies supported this finding revealing that the use of context-based teaching materials in the lesson ensures the students to better comprehend the topics and helps them to materialize abstract concepts (Aşkın Tekkol & Bozdemir Yüzbaşıoğlu, 2022; Kistak, 2014; Tekbıyık, 2010; Ültay & Ültay, 2012).

Pursuant to the curriculum of the science course, the unit entitled Measurement of Force and Friction aims to teach students how the magnitude of the force can be measured using a dynamometer, to enable students to observe the effect of frictional force on movement on different surfaces, to make students aware of the significance and importance of friction force in daily life and to provide students creative and innovative thinking skills by allowing them to combine the knowledge they acquired about increasing and reducing the friction force with their own ideas (MoNE, 2018). Kara (2016) stated that context-based course materials helped students to acquire information that they can use in daily life in the lessons and that this information is more permanent in their minds. Students interviewed in the current research stated that they had the opportunity to put the knowledge they acquired during the CBC courses into practice by using the materials or tools they found in their close environment. In this regard, the students developed a dynamometer using the materials they found, made measurements with the dynamometer they found when they went to the village or drove their toy cars or bicycles in different environments to compare/observe the effect of frictional force. In this way, they also had the opportunity to observe the different applications of the information they acquired at school. Individuals tend to produce solutions to problems much more easily if they are familiar with them from their daily lives compared to other scientific problems (Whitelegg & Parry, 1999). One of the reasons why students cannot offer solutions to the problems they encounter in their daily lives is that they cannot transfer the information acquired at school to their daily lives (Burbules & Linn, 1991). The course teacher expressed that a student finds the opportunity to see the equivalent of the knowledge acquired at school when he goes outside the classroom, as the examples included in the comic book are taken directly from everyday life. It was further reported that students realized the equivalent of the information/knowledge they acquired in the lessons taught with comic books in the environments they visited outside the school and that they shared this experience in the classroom by establishing the relevant associations. Accordingly, the students included in the current research connected real-life events they encountered with the information taught through the CBC Book, provided explanations or carried out various applications within the bounds of their possibilities. Based on these findings, it is possible to argue that CBC Book contributes to students' ability to see the use of the information they acquired in daily life, allowing them to make the necessary associations and use them in possible situations.

The theme "Comic Books and Humor" explored whether the students wanted any amendments with regard to the structure, illustrations, or humorous elements of the CBC Book and their opinions about the continuation of the use of comic books and the implementing course teacher's views about the use, humorous elements, and the amendments on the CBC Book. Students stated that they were very impressed and excited by the illustrations and the context when they read the comic book. The use of illustrations along with texts for the narration of the subject covered in comic books has been known to capture individuals' attention (Green & Myers, 2010; Hutchinson, 1949; Ünal, 2018). Accordingly, students pointed out that the illustrations included in the structure of the CBC book were quite effective in complementing the information presented in the writing. Students find lessons taught with context-based materials interesting when the course materials are rich in illustrations and include problems that

are relevant to their daily lives (Akbulut, 2013). The humorous elements of the comic book are known to attract the attention and interest of individuals (Çiçek Şentürk, 2020; Lin et al., 2015; Topkaya & Şimşek, 2016). Students said that they were much more entertained when learning a certain subject while two brothers were saying bandy words to each other, while they were racing with each other, while school friends were saying bandy words to each other, and in the episodes where other humorous elements were predominant. Implementing course teacher similarly stated that the students had fun in the sections where the most humorous elements were frequent while reading the comic books. In addition to the illustrations and humorous elements included in the structure of the comic book, the presentation of examples from everyday life in the teaching environment further motivates students for the lesson (Çiçek Şentürk, 2020). Accordingly, the presentation of information in connection with everyday life accompanied by adventures for the purpose of the current research turned CBC Book into a course material in a different style than the textbooks that students were used to serve to present the "Ha-ha!" of humor together with the "A-ha!" of learning. In the courses taught using materials prepared according to the context-based approach, students expressed that these materials led them to think, to better understand their environment, and to gain problem-solving skills because the lessons were related to daily life (Tulum, 2019). In the current research, students also stated that CBC Book is both entertaining and informative.

It was concluded that students waited for the next lesson with enthusiasm when the course was designed according to the context-based approach and that this method encouraged their participation in the lesson (Karslı & Yiğit, 2017). The students interviewed in the current research stated that they liked the structure of the CBC Book, they were entertained when they read it, and that they better understood the subject intended to be taught; so, they wanted to read similar comics. The use of comic books has the potential to reduce the amount of text presented to the students and to associate the information taught with everyday life (Affeldt et al., 2018). Owing to the illustrations and texts included in their structure, comic books have the potential to offer more information to students in an entertaining way compared to traditional textbooks (Hosler & Boomer, 2011). The students stated that the text-dominant content of the textbooks was boring and suggested comic books be used in courses other than science. Some of the students interviewed revealed that they looked for similar comic books in the bookstores, and they found examples of comic books that were not related to the lessons, but they had difficulty finding comics that were directly related to their lessons. The students were further asked which amendments they would like to make to the comic book. Some of them said that the comic books could be colorful, while the majority stated that they were already beautiful as such and there was no need for any amendments. The students stated that there were no sections in the comic book that bored them or that they wanted to be removed. They further said that they would like to have comic books in which the characters are the same, but there are adventures related to different course subjects. Implementing course teacher was asked whether there was any amendment that he wanted to make to the CBC Book used while teaching the lesson, but the answer revealed that the current CBC Book used was sufficient and there was no need for any amendments. The teacher was further asked whether any differences would occur during the implementation in the case of using colored comics

as suggested by some of the students, but the teacher's opinion stating said he would not expect any difference, so the CBC Book could remain as it was considered to be significant.

Based on all these findings, CBC Book was appreciated by both students and the implementing course teacher in terms of its academic, and affective, ability to associate information with everyday life and structural features, and it was concluded that further episodes of CBC Book would satisfy both students and teachers. The courses taught through the CBC Book were found to improve students' interest in the lesson and enabled them to put the knowledge they acquired into practice in their daily lives and to do activities at home without any homework being assigned by the teachers. Supporting students' interest in daily life in educational environments is known to positively affect their interest in science (Siverton, 1993). Effectively conducted science education will serve to develop individuals' research skills, help students to understand the significance of science, and will ensure them to be raised to become future scientists (Slavin et al., 2014). For this reason, students of this age should experience more than watching a bean planted in a glass grow in the classroom environment (James B. Hunt, Jr. Institute for Educational Leadership and Policy, 2007). In this way, students will have the opportunity to transfer the knowledge they acquired at school to new situations and to offer solutions to the problems they encounter in their daily lives.

The CBC Book prepared within the scope of the research served to break down the walls of the school environment and to lift the lid off between the classroom and real life. Interviews held with a teacher and students revealed that the CBC Book prepared within the scope of the research allowed them to answer the question, "What will I do with this information?". The humorous aspect of the CBC Book and the humorous elements presented in its content were found to capture the students' attention. It should not be forgotten that there is a close relationship between the "Ha-ha!" of humor and the "A-ha!" of learning.

It is possible to conclude that the CBC Book may be used as an effective course material for further units and courses on the grounds that it makes the subject matter entertaining and comprehensible, facilitates learning, provides an opportunity for a permanent learning experience and individual learning, encourages class participation and supports the learning processes of students with literacy and language problems. Comic books can also be prepared and used in lessons that students are biased about learning, have difficulty understanding, and find boring or abstract. Furthermore, course teachers may be provided practical training on the preparation of comic books and their use in teaching environments.

Acknowledgements

The authors would like to thank all participants.

Statement of Responsibility

Mustafa Kemal Yüzbaşıoğlu; design of the research process, conceptualization, writing, methodology, selection of data collection tools, data collections, data analysis. Mehmet Altan Kurnaz; advising, design of the research process, writing, review and editing, methodology, selection of data collection tools, data analysis.

Conflicts of Interest

The authors declare no conflict of interest.

Author Bios:

Mustafa Kemal Yüzbaşıoğlu is a science teacher at the Ministry of National Education. His current research interests are science education, sustainable development, context-based learning, comics.

Mehmet Altan Kurnaz is a Professor in the Department of Mathematics and Science Education at Kastamonu University. His current research interests are physics education, science education, grounded mental model theory, models and modelling, alternative ideas, context-based learning.

References

Affeldt, F., Meinhart, D., & Eilks, I. (2018). The use of comics in experimental instructions in a non-formal chemistry learning context. *International Journal of Education in Mathematics Science and Technology, 6*(1), 93-104. doi: 10.18404/ijemst.380620.

Afrilyasanti, R., & Basthomi, Y. (2011). Adapting comics and cartoons to develop 21st century learners. *Language in India, 11*(11), 552-568.

Akbulut, Ö. E. (2013). *Dokuzuncu sınıf kuvvet ve hareket ünitesine yönelik bilgisayar destekli bağlam temelli öğretim etkinliklerinin incelenmesi [The investigation of computer aided context-based teaching activities for 9th grade force and motion unit]* [Doctoral dissertation]. Karadeniz Technical University.

Akbulut, H. İ., & Çepni, S. (2013). Bir üniteye yönelik başarı testi nasıl geliştirilir? İlköğretim 7. sınıf kuvvet ve hareket ünitesine yönelik bir çalışma [How to develop an achievement test for a unit? A study for grade 7 force and motion unit]. *Amasya Education Journal, 2*(1), 18-44.

Akın Yanmaz, E. (2021). *Bağlam temelli öğrenme yaklaşımına göre geliştirilen rehber materyallerin ortaokul 7. sınıf öğrencilerinin kavramsal anlamaları üzerine etkisi: "Aynalar ve ışığın soğurulması" örneği [The effect of guide materials developed according to context-based learning approach on the conceptual understanding of 7th grade students: "Mirrors and absorption of light"]* [Master's thesis]. Giresun University.

Alsaç, Ü. (1994). *Türkiye'de karikatür, çizgi roman ve çizgi film.* İstanbul: İletişim

Aşkın Tekkol, İ., & Bozdemir Yüzbaşıoğlu, H. (2022). İlkokul ve ortaokul fen bilimleri ders kitaplarının günlük yaşam ile ilişkilendirilmesinin incelenmesi. T. Çetin, G. Kılıçoğlu & E. Sözen (Eds.), Eğitimde kuramsal ve uygulamalı akademik araştırmalar 1 (pp.435-451). İstanbul: Hiper Yayın.

Bennett, J., Lubben, F., & Hogarth, S. (2007). Bringing science to life: A synthesis of the research evidence on the effects of context-based and STS approaches to science teaching. *Science Education, 91*(3), 347-370.

Bennett, J. (2016). Bringing science to life: Research evidence. In Taconis, R., den Brok, P., & Pilot, A. (Eds.), *Teachers creating context-based learning environments in science* (pp. 21-41). Rotterdam: Sense.

Bozdemir Yüzbaşıoğlu, H., Ezberci Çevik, E., & Kurnaz, M. A. (2020). Fen bilgisi öğretmen adaylarının yansıma ve kırınım konusundaki bağlamlaşmış bilgileri

[*Contextualized knowledge of pre-service science teachers on reflection and diffraction*]. *Van Yüzüncü Yıl University Journal of Education, 17*(1), 722-740.

Burbules, N. C., & Linn, M. C. (1991). Science education and philosophy of science: congruence or contradiction? *International Journal of Science Education, 13*(3), 227-241.

Canlas, I. P. (2021). Using visual representations in identifying students' preconceptions in friction. *Research in Science & Technological Education, 39*(2), 156-184.

Cantek, L. (2014). *Türkiye'de çizgi roman.* İstanbul: İletişim.

Cheesman, K. (2006). Using comics in the science classroom. *Journal of College Science Teaching, 35*(4), 48-51.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches.* Sage Publication.

Çelik, B. (2021). *Fen bilimleri öğretmen adaylarının madde ve ısı ünitesinde hazırlanan bağlam temelli öğrenme etkinlikleri hakkındaki görüşleri [The views of pre-service science teachers about the activities of context-based learning in the matter and heat unit]* [Master's thesis]. Erciyes University.

Çiçek Şentürk, Ö. (2020). *Argümantasyon destekli eğitici çizgi romanların öğrencilerin çevreye yönelik ilgi, motivasyon ve akademik başarılarına etkisi ile öğrenci deneyimleri [The effect of argumentation-supported educational comics on students' environmental interests, motivation, and academic achievements and student experiences]* [Doctoral dissertation]. Gazi University.

Doğan, H. (2020). *Beşinci sınıf fen bilimleri dersi ünitelerinin bütünleşik STEM eğitimi yaklaşımı ile tasarlanması, uygulanması ve değerlendirilmesi [Design, implementation and evaluation of fifth grade science course units with an integrated STEM education approach]* [Doctoral dissertation]. Pamukkale University.

Fensham, P. J. (2009). Real world contexts in Pisa science: implications for context based science education. *Journal of Research in Science Teaching, 46*(8), 884- 896.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education.* New York: McGraw-Hill.

Gilbert, J. K. (2006). On the nature of "context" in chemical education. *International Journal of Science Education, 28*(9), 957-976.

Gitari, W. (2016). The application of school science by urban high school youth through problem-solving in everyday life. *Science Education International, 27*(3), 344-368.

Green, M. J., & Myers, K. R. (2010). Graphic medicine: use of comics in medical education and patient care. *The BMJ, 340*(863). http://dx.doi.org/10.1136/bmj.c863.

Groensteen, T. (2007). *The system of comics.* Jackson, MS: University Press of Mississippi.

Gülen, G., & Bozdoğan, A. E. (2021). Fen bilimleri öğretmenlerinin derslerinde okul bahçelerini kullanma durumlarının incelenmesi [The evaluation of the use of school gardens by science teachers in their lectures]. *Turkish Journal of Primary Education, 6*(1), 89-108.

Güven, Ç., Selvi, M., & Benzer, S. (2018). 7E öğrenme modeli merkezli STEM etkinliğine dayalı öğretim uygulamalarının akademik başarıya etkisi [Teaching applications' based on 7e learning model centered stem activity effect on academic

achievement]. *Journal of Social Sciences of Mus Alparslan University, 6*(STEMES'18), 73-80.

Hacıoğlu, Y. (2020). Tematik STEM eğitimi uygulaması: Sürtünme kuvveti örneği [Implementation of Thematic STEM Education: Friction Force Example]. *Bogazici University Journal of Education, 37*, 3-21.

Haugen, D. M. (2005). *Comic books: Examining pop culture.* Farmington Hills. MI: Thomson Gale.

Hırça, N. (2012). Bağlam temelli öğrenme yaklaşımına uygun etkinliklerin öğrencilerin fizik konularını anlamasına ve fizik dersine karşı tutumuna etkisi [The effects of hands on activities depend on context-based learning approach on understanding of physics and attitudes]. *Mustafa Kemal University Journal of Social Sciences Institute, 9*(17), 313-325.

Hosler, J., & Boomer, K. B. (2011). Are comic books an effective way to engage non majors in learning and appreciating science? *CBE—Life Sciences Education, 10*(3), 309-317. https://doi.org/10.1187/cbe.10-07-0090.

Hoşgören, G. (2018). *Bağlam temelli kavram karikatürlerinin asit-baz konusunun öğretiminde etkililiğinin incelenmesi [An investigation of effectiveness of context based concept cartoons in teaching acid-base subject]* [Master's thesis]. Kilis 7 Aralık University.

Hutchinson, K. H. (1949). An experiment in the use of comics as instructional material. *The Journal of Educational Sociology, 23*(4), 236-245.

Ishimoto, M. (2010). Preconceptions of Japanese students surveyed using the force and motion conceptual evaluation. In *International Conference on Physics Education*, 147–50. 1263 vols. American Institute of Physics.

İlhan, G. O. (2016). *Sosyal bilgiler öğretiminde çizgi romanların kullanımı [Use of comics in social studies teaching]* [Doctoral dissertation]. Afyon Kocatepe University.

James B. Hunt, Jr. Institute for Educational Leadership and Policy. (2007). *K-8 science education: Elements that matter: A Report from the 2007 North Carolina science summit.*

Kara, F. (2016). *5. sınıf "Maddenin Değişimi" ünitesinde kullanılan bağlam temelli öğrenmenin öğrencilerin bilgilerini günlük yaşamla ilişkilendirme düzeyleri, akademik başarıları ve fene yönelik tutumlarına etkisi [The effect of context based learning used in 5th grade 'change of substance' unit on the students' levels of association the knowledge with daily life, academic achievements and attitudes towards science lesson]* [Doctoral dissertation]. Ondokuz Mayıs University.

Karslı, F., & Yiğit, M. (2017). Effectiveness of the REACT strategy on 12th grade students' understanding of the alkenes concept. *Research in Science & Technological Education, 35*(3), 274-291.

Kılıç, A., & Seven, S. (2007). *Konu alanı ders kitabı incelmesi.* Ankara: Pegem A Yayıncılık.

Kırıcı, M. G., Artun, H., & Bakırcı, H. (2018). Eğitim bilişim ağı destekli eğitimin kuvvetin ölçülmesi ve sürtünme kavramlarının öğrenilmesine etkisi [Influence of education information network aided with on teaching the concepts of "measurement of force and friction"]. *Turkish Studies, 13*(6), 23-38.

Kireççi, Ü. (2008). *Çizgi roman senaryosu önce yazı sonra çizgi.* İstanbul: Crea.

Kistak, Ö. (2014). *İlköğretim 8. sınıf fen ve teknoloji dersi ses ünitesinin yaşam temelli yaklaşımla öğretimi [Teaching the 'sound' unit with context-based learning at eight grades in science and technology lesson]* [Master's thesis]. Balıkesir University.

Kurnaz, M. A., & Çalık, M. (2008). Using different conceptual change methods embedded within 5e model: a sample teaching for heat and temperature. *Journal of Physics Teacher Education Online, 5*(1), 3-10.

Kurnaz, M. A., & Ekşi, C. (2015). An analysis of high school students' mental models of solid friction in physics. *Educational Sciences: Theory and Practice, 15*(3), 787-795.

Kurt, S. (2019). *Sosyal bilgiler öğretiminde çizgi roman kullanımına ilişkin sosyal bilgiler öğretmen adaylarının görüşlerinin incelenmesi [Examining the opinions of social studies teacher candidates on the use of comics in teaching social studies]* [Master's thesis]. İstanbul University.

Külekci, E. (2019). *Kavram karikatürü destekli probleme dayalı fen, teknoloji, mühendislik ve matematik (FeTeMM) etkinliklerinin beşinci sınıf fen bilimleri öğretimi üzerindeki etkileri [Effects of concept cartoon assisted problem based science, technology, engineering and mathematics (stem) activities on 5th grade science teaching]* [Master's thesis]. Manisa Celal Bayar University.

Lay, Y. F., Khoo, C. H., Treagust, D. F., & Chandrasegaran, A. L. (2013). Assessing secondary school students' understanding of the relevance of energy in their daily lives. *International Journal of Environmental and Science Education, 8*(1), 199-215.

Lazzarich, M. (2013). Comic strip humour and empathy as methodological instruments in teaching. *Croatian Journal of Education, 15*(1), 153-190.

Lin, S.-F., Lin, H., Lee, L., & Yore, D. L. (2015). Are science comics a good medium for science communication? The case for public learning of nanotechnology. *International Journal of Science Education, 5*(3), 276–294.

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation.* New Jersey: John Wiley & Sons.

Metcalf, S. J. & Tinker, R.F. (2004). Probeware and handhelds in elementary and middle school science. *Journal of Science Education and Technology, 13*(1), 43-49.

MoNE. (2018). *Fen bilimleri dersi öğretim programı (İlkokul ve Ortaokul 3, 4, 5, 6, 7 ve 8. Sınıflar) [Elementary science lesson (primary and secondary school 3-8th grades) curriculum]*. Ankara: Millî Eğitim Bakanlığı Temel Eğitim Genel Müdürlüğü.

Mustafaoğlu, F. M. (2019). *Kimya öğretmenlerinin bağlam temelli etkinlik hazırlama ve uygulama becerilerinin geliştirilmesi [Developing chemistry teachers skills for designing and implementing context based activities]* [Doctoral dissertation]. Hacettepe University.

Mutlu, Z. (2019). *Sosyal bilgiler öğretmen adaylarının sosyal bilgiler öğretiminde çizgi roman kullanımına yönelik görüşleri [The opinions of the social studies teacher candidates on using comics during the process of teaching social studies]* [Master's thesis]. Mugla Sıtkı Kocman University.

Olson, J. C. (2008). *The comic strip as a medium for promoting science literacy* [Master's thesis]. California State University.

Orçan, A. (2013). *Çizgi-roman tekniği ile geliştirilen bilim-kurgu hikâyelerinin öğrencilerin yaratıcı düşünme becerilerinin ve fiziğe ilişkin tutumlarının gelişimine*

etkisi [The effect of science-fiction stories developed by comics technique, on creative thinking skills and physics attitudes of students] [Master's thesis]. Gazi University.

Patton, M. Q. (2015). *Qualitative research & evaluation methods: Integrating theory and practice.* Thousand Oaks, California: SAGE Publications.

Pilot, A., & Bulte, A. M. W. (2006). The use of "contexts" as a challenge for the chemistry curriculum: Its successes and the need for further development and understanding. *International Journal of Science Education, 28*(9), 1087- 1112.

Rose, D. E. (2012). Context-based learning. In N. Seel (Ed.), *Encyclopedia of the sciences of learning* (pp. 799- 802). Springer.

Rota, G., & Izquierdo, J. (2003). "Comics" as a tool for teaching biotechnology in primary schools. *Issues in Biotechnology Teaching, 6*(2), 85-89.

Sarıbıyık, M. S. (2018). *İlkokullarda milli tarih şuurunu kazandırmada tarihi çizgi romanların önemi: Tarkan çizgi romanları örneği [The importance of historical graphic novels to cause the students to gain national conscience in elementary schools: The sample of Tarkan graphic novels]* [Master's thesis]. Giresun University.

Sari, Ö. (2010). *İlköğretim 5. sınıf öğrencilerine dünya ve evren öğrenme alanında bağlama dayalı yaklaşımın benimsendiği bir materyalin geliştirilmesi [Developing a material based on the context based approach on the topic 'the earth and the universe' for the 5th grade primary students]* [Master's thesis]. Gazi University.

Schiefele, U., Schaffner, E., Möller, J., & Wigfield, A. (2012). Dimensions of reading motivation and their relation to reading behavior and competence. *Reading Research Quarterly, 47*(4), 427-463.

Schwartz, A. T. (2006). Contextualised chemistry education: The American experience. *International Journal of Science Education, 28*(9), 977-998.

Siverton, M. L. (1993). *Transforming ideas for teaching and learning science.* Washington, DC: US Department of Education.

Slavin, R. E., Lake, C., Hanley, P., & Thurston, A. (2014). Experimental evaluations of elementary science programs: A best-evidence synthesis. *Journal of Research in Science Teaching, 51*(7), 870-901.

Solvang, L., & Haglund, J. (2021). Learning with friction—students' gestures and enactment in relation to a GeoGebra simulation. *Research in Science Education*, 1-17.

Sözbilir, M., Sadi, S., Kutu, H., & Yıldırım, A. (2007). Kimya eğitiminde içeriğe/bağlama dayalı (context-based) öğretim yaklaşımı ve dünyadaki uygulamaları. *I. Ulusal Kimya Eğitimi Kongresi*, s. 108.

Spiegel, A. N., McQuillan, J., Halpin, P., Matuk, C., & Diamond, J. (2013). Engaging teenagers with science through comics. *Research in Science Education, 43*(6), 2309-2326.

Taşkın, T., & Moğol, S. (2017). Fizik eğitiminde yaratıcı drama yöntemine bir örnek: sürtünme kuvveti [An example for creative drama in physics education: friction force] *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education, 11*(1), 198-221.

Tatalovic, M. (2009). Science comics as tools for science education and communication: a brief, exploratory study. *Journal of Science Communication, 8*(4), 1-17.

Tavukçuoğlu, E. (2018). *Lise öğrencilerinin sürtünme kuvveti, ivme ve eylemsizlik kavramlarıyla ilgili bilişsel yapılarının araştırılması [Investigating high school students' cognitive structures about friction, acceleration and inertia concepts]* [Master's thesis]. Hacettepe University.

Tekbıyık, A. (2010). *Bağlam temelli yaklaşımla ortaöğretim 9. sınıf enerji ünitesine yönelik 5E modeline uygun ders materyallerinin geliştirilmesi [Development of course materials integrating context based approach into 5E model in terms of energy unit for 9th grade secondary students]* [Doctoral dissertation]. Karadeniz Teknik University.

Topkaya, Y. (2014). *Vatandaşlık ve demokrasi eğitimi dersinde eğitici çizgi roman kullanımının bilişsel ve duyuşsal öğrenmelere etkisi* [*Impact of usage of comics on cognitive and emotional learning in citizenship and democracy education classes]* [Doctoral dissertation]. Atatürk University.

Topkaya, Y., & Şimşek, U. (2016). The effect of educational comics on the academic achievement and attitude towards earthquake. *International Online Journal of Educational Sciences, 8*(3), 46-54.

Tulum, G. (2019). *Fen bilimleri dersi ışık konusuna yönelik geliştirilen bağlam temelli materyalin akademik başarı üzerine etkisi [The effect of context-based material on academic achievement in light science course]* [Master's thesis]. Ondokuz Mayıs University.

Tuncer, N. (1993). *Çizgi roman ve çocuk.* İstanbul: Çocuk Vakfı.

Ültay, E. (2012). Implementing REACT strategy in a context-based physics class: Impulse and momentum example. *Energy Education Science and Technology Part B: Social and Educational Studies, 4*(1), 233-240.

Ültay, E., & Ültay, N. (2012). Designing, implementing and evaluating a context-based instructional materials on buoyancy force. *Energy Education Science and Technology Part B: Social and Educational Studies, 4*, 201-205.

Ültay, E. (2014). *İtme, momentum ve çarpışmalar konusuyla ilgili bağlam temelli öğrenme yaklaşımına dayalı açıklama destekli REACT stratejisine göre geliştirilen etkinliklerin etkisinin araştırılması [Investigating the effect of the activities based on explanation assisted REACT strategy in context-based learning approach on impulse, momentum and collisions]* [Doctoral dissertation]. Karadeniz Teknik University.

Ültay, N. (2015). The effect of concept cartoons embedded within context-based chemistry: Chemical Bonding. *Journal of Baltic Science Education, 14*(1), 96–108.

Ünal, O. (2018). *Sosyal bilgiler dersinde eğitici çizgi roman kullanımının öğrenci başarısı ve tutumuna etkisi [The effect of using educational comics in social studies course on students' success and attitudes]* [Master's thesis]. Akdeniz University.

Ünal, O., & Demirkaya, H. (2019). A semi-experimental study on the use of educational comics in social studies. *International Journal of Geography and Geography Education* (IGGE), *40*, 92-108.

Vos, M. A. J., Taconis, R., Jochems, W. M. G., & Pilot, A. (2011). Classroom implementation of context-based chemistry education by teachers: The relation

between experiences of teachers and the design of materials. *International Journal of Science Education, 33*(10), 1407-1432.

Whitelegg, E., & Parry, M. (1999). Real-life contexts for learning physics: meanings, issues and practice. *Physics Education 34*(2), 68–72.

Wood, M. (2015). *The effect of graphic novel supplements on reading comprehension and motivation in secondary students* [Doctoral dissertation]. University of Central Arkansas.

Yıldırım, E. (2016). Sınıf öğretmeni adaylarının eğitici çizgi roman hakkındaki görüşlerinin incelenmesi [Examining opinions of classroom teacher candidates on educational comics]. *Kilis 7 Aralık Üniversitesi Sosyal Bilimler Dergisi, 6*(11), 52-70.

Yüzbaşıoğlu, M. K. (2022). *"Kuvvetin ölçülmesi ve sürtünme" ünitesine yönelik bağlam temelli tasarlanan çizgi romanların öğrencilerin temellendirilmiş zihinsel model gelişimine etkisi [The effect of context based comics for the 'measurement of force, and friction' unit on the development of students' grounded mental model]* [Doctoral dissertation]. Kastamonu University.

Yüzbaşıoğlu, M. K., & Kurnaz, M. A. (2022a). Fen eğitiminde çizgi roman. In H. Bozdemir Yüzbaşıoğlu & E. Ezberci Çevik (Eds.), *Güncel gelişmeler odağında fen öğretimi* (pp.327-347). Ankara: Pegem Akademi.

Yüzbaşıoğlu, M. K., & Kurnaz, M. A. (2022b). Ortaokul öğrencilerinin kuvvetin ölçülmesi ve sürtünme ünitesine yönelik alternatif fikirlerinin incelenmesi: Skor analizi [*Investigation of secondary school students' alternative ideas for "measuring of force and friction" Unit: Score analysis]*. *Mehmet Akif Ersoy University Journal of Education Faculty, 61*, 1-22.

Appendix

Appendix-1 Comic Book Student Interview Form

1- Have you read comic books before? If yes, will you please mention the comics you've read?

2- What do you think about the use of a comic book in science class?

3- Do you think other units in the science course can be taught with a comic book?

4- How did you feel when learning the subject with a comic book?

5- What did you think when learning the subject with a comic book?

6- Did you have fun when learning the subject with the comic book?

a- Can you mention the entertaining parts?

7- Were you bored when learning the subject with the comic book?

b- Can you mention any boring parts?

8- Which other courses do you think comic books can be used?

9- Did the comic book help you associate the information you learned at school with everyday life?

10- Which parts of this comic book would you change, if you were given the opportunity to do so?

Appendix-2 Comic Book Teacher Interview Form

1- Have you read comic books before? If yes, will you please mention the comics you've read?

2- Can you please tell us about your opinions about teaching with comic book?

a- What were your thoughts about the use of a comic book before the implementation?

b- What were your thoughts about the use of a comic book after the implementation?

c- Did you have any challenges while teaching with the comic book?

d- Did the comic book facilitated your teaching?

3- What kind of reactions did you get from the students in general when you were teaching with the comic books?

a- In which parts did you receive positive feedback?

b- In which parts did you receive negative feedback?

4- Can you tell us about your other course designs? What are the main differences between teaching with a comic book?

5- How did teaching with a comic book affect your lessons?

6- Do you think comic books can be used while teaching other units of the science course?

Journal of Theoretical Educational Science, 16(3), 574-595, July 2023
Kuramsal Eğitimbilim Dergisi, 16(3), 574-595, Temmuz 2023
[Online]: http://dergipark.org.tr/akukeg
DOI number: http://doi.org/10.30831/akukeg.1190159

The Effect of Context-Based STEM Activities on Secondary School Students' Scientific Literacy and STEM Motivation*

Bağlam Temelli STEM etkinliklerinin Ortaokul Öğrencilerinin Bilimsel Okuryazarlık ve STEM Motivasyonları Üzerine Etkisi

Faruk ŞİMŞEK** **Ergin HAMZAOĞLU*****

Received: 16 October 2022 **Research Article** **Accepted:** 28 June 2023

ABSTRACT: The importance of this research is to determine the effect of integrating the REACT strategy, which is a practice of the context-based learning method, with STEM education on students' scientific literacy and STEM motivation. The research was conducted with 82 seventh-grade students. A quasi-experimental design with a pre-test and post-test control group was used. The study group of the research consists of three seventh-grade classrooms selected by simple random sampling method. Scientific literacy scale and STEM motivation scale were used as data collection tools in the research. Before the implementation, these scales were administered to all three groups as a pre-test. Then, context-based REACT strategy-supported STEM activities were administered to the experimental-I group, context-based REACT strategy-supported activities to the experimental-II group, and science practicing teaching program to the control group. After practicing, the scales were applied to the groups as a post-test. ANCOVA test was used in the analysis of the data. According to the data obtained from the research, it has been found that the experimental-I group, in which context-based STEM activities were implemented, showed a higher level of positive impact on scientific literacy and STEM motivation compared to the control groups, which received context-based learning activities in experiment-II and science practice curriculum.

Keywords: STEM, context-based learning, REACT strategy, scientific literacy, STEM motivation.

ÖZ: Bu çalışmanın amacı, bağlam temelli öğrenme yönteminin bir uygulaması olan REACT stratejisinin STEM eğitimi ile entegrasyonunun, öğrencilerin bilimsel okuryazarlık ve STEM motivasyon üzerine etkisini tespit etmektir. Araştırma 2021-2022 eğitim-öğretim yılında yedinci sınıfta öğrenim gören 82 öğrenci ile yürütülmüştür. Araştırmada ön test son test kontrol gruplu yarı deneysel desen kullanılmıştır. Araştırmanın çalışma grubunu basit seçkisiz örneklem yöntemiyle seçilen ve yedinci sınıfta öğrenim gören üç sınıf oluşturmaktadır. Araştırmada veri toplama aracı olarak bilimsel okuryazarlık ölçeği ve STEM motivasyon ölçeği kullanılmıştır. Uygulama öncesi bu ölçekler ön test olarak üç gruba da uygulanmıştır. Ardından deney-I grubuna bağlam temelli REACT strateji destekli STEM etkinlikleri, deney-II grubuna bağlam temelli REACT strateji destekli etkinlikler ve kontrol grubuna bilim uygulamaları öğretim programı uygulanmıştır. Uygulamanın tamamlanmasıyla ölçekler gruplara son test olarak uygulanmıştır. Verilerin analizinde ANCOVA testi kullanılmıştır. Araştırmadan elde edilen verilere göre, bilimsel okuryazarlık ve STEM motivasyon yönünden bağlam temelli STEM etkinlikleri uygulanan deney-I grubunun olumlu etkilenme düzeyinin, bağlam temelli öğrenme etkinlikleri uygulanan deney-II ve bilim uygulamaları öğretim programı uygulanan kontrol gruplarına göre daha fazla olduğu tespit edilmiştir.

Anahtar kelimeler: STEM, bağlam temelli öğrenme, REACT stratejisi, bilimsel okuryazarlık, STEM güdülenme.

*This article is derived from Faruk Şimşek's PhD dissertation entitled "The effect of context based learning STEM activities on students' scientific literacy and motivation for stem, as well as their attitudes and concerns about science", conducted under the supervision of Ergin Hamzaoğlu.

** *Corresponding Author*: Dr., Ministry of National Education, Osmaniye, Türkiye, faruksimsekfs@gmail.com, https://orcid.org/0000-0001-9559-198X
*** Prof. Dr., Gazi University, Ankara, Türkiye, erginhamzaoglu@gazi.edu.tr, https://orcid.org/0000-0001-6053-6796

Citation Information
Şimşek, F., & Hamzaoğlu, E. (2023). The effect of context-based STEM activities on secondary school students' scientific literacy and STEM motivation. *Kuramsal Eğitimbilim Dergisi [Journal of Theoretical Educational Science], 16*(3), 574-595.

ISSN: 1308-1659

The rapid changes in science and technology in the 21st-century world have directly or indirectly impacted individuals and society (Friedman, 2007). This situation has made it necessary for individuals in the 21st century to be equipped to meet the era's demands (Clark, 2010; Iwuanyanwu, 2019). Especially when this change is evaluated in terms of education, it has brought different approaches to learning and teaching, and reforms have been made in education.

In order to reflect the changes in the education system in Turkey to the science curriculum, updates were made in 2005, 2013, and 2018 (Özcan & Koştur, 2019). In this context, context-based learning was included in the science curriculum in 2005, and a transition was made from the traditionalist learning paradigm to constructivist learning (Topuz et al., 2013) Context-based learning is essentially a learning model in which individual differences are taken into account. Its aim is to establish a link between daily life and science and to explain the situations that students encounter or may encounter with the science content (Ültay & Çalık, 2011). Thus, a step was taken towards integrating science into life, and science literacy was included in the science program for the first time in this direction. In 2013, inquiry-based learning was included in the science curriculum. Finally, in 2018, STEM education, in which 21st-century skills and science, technology, engineering, and mathematics disciplines (under the title of engineering and design skills) are recruited, was included in science curriculum teaching (Ministry of National Education [MoNE], 2018). STEM mentioned here is an interdisciplinary collaborative learning model consisting of the initials of the words "Science, Technology, Engineering, Mathematics" (Dugger, 2010; Li, 2014; Sanders, 2009; Vasque et al., 2013).

STEM Education

One of the reasons STEM education has gained importance in Turkey is that desired results are not achieved due to being below the average score of the Organisation for Economic Co-operation and Development (OECD) countries in international exams such as PISA and TIMSS. These exams serve as indicators of the significance countries place on STEM education (Kadijevich, 2019). In addition, economic concerns highlighted the need for STEM education to be included in the science curriculum (Akgündüz et al., 2015). Because STEM education is necessary for a country's economic competitiveness and social well-being, it is accepted as the basis of national development and productivity (Lacey & Wright, 2009; Marginson et al., 2013; Thomas, 2014). One of the goals of STEM education is to train individuals with advanced 21st-century skills and to bring them into society (Olivarez, 2012). This is one of the reasons why STEM is included in the science curriculum in Turkey.

STEM education entered the science curriculum in Turkey in 2018, but various problems were encountered in its implementation. These are the problems that science teachers are afraid of in STEM practice; teacher competencies are not at an appropriate level, material problems, and problems arising from the nature of cooperative teaching (Özbilen, 2018). In addition, there is literature in which teachers do not have enough knowledge about STEM (Yıldırım, 2017). Therefore, there is a need for more explanatory STEM activities for teachers.

There are many teaching models that can be used with STEM, but it is not known which one will work best (Dugger, 2010). As a matter of fact, when examining studies conducted both abroad (Geng et al., 2019) and in Turkey (Hacıoğlu et al., 2016),

it becomes evident that STEM education is not at a sufficient level and is implemented with different methods and techniques. For this purpose, context-based learning, which was included in the science curriculum in Turkey in 2005 (Topuz et al., 2013), may be an alternative approach that can be used for STEM integration. Context-based learning is a model that aims to achieve lasting learning by establishing connections between subjects and daily life, aligning with the goal of STEM education to generate solutions for real-life problems encountered by students (Moore et al., 2014). Constructivist learning theory is the basis of context-based learning (Glynn & Koballa, 2005; Stinner, 2006). In constructivist learning theory, there is a learning environment in which the students construct the knowledge themselves and are at the center of the learning process (Brooks & Brooks, 1993; Rezaei & Katz, 2002).

Context-Based Education

The starting point of the context-based learning approach is that students have difficulties understanding science subjects (Osborne & Collins, 2001) and low interest in science lessons (OECD, 2006). In curriculums (such as PLON, ChemCon) prepared with the context-based learning approach in mind, the content is designed to increase student interest (Parchmanna et al., 2006) and enable students to actively participate in the lesson in line with their interests (Glynn & Winter, 2004).

When the studies on the context-based learning approach in the literature are examined, it is seen that different teaching methods, such as 5E, the four-stage model, and REACT, are applied (Gilbert et al.,2011; Patro, 2008). Among these models, it is seen that the REACT strategy is increasingly taking place in academic studies (Yiğit, 2015). With the REACT strategy, students will be able to relate the knowledge they have learned to real-life situations, actively engage in the learning environment and move away from the rote learning approach (Ültay & Çalık, 2011). The REACT strategy is formed by combining the initials of the words “Relating,” “Experiencing,” “Applying,” “Cooperating,” and “Transferring” (Crawford, 2001; Hull, 1999).

In the relating stage, a link is established between the prior knowledge or life experiences of individuals and the knowledge (subject). In the experiencing phase, there is learning by doing, experiencing, and developing a project and/or in a laboratory environment. Applying is the stage where useful concepts are introduced and learned. In the cooperating phase, there is communication with other students. In the transfer phase, the previously learned information is transferred to a situation encountered for the first time (Crawford, 2001; Hull, 1999).

Scientific literacy

Scientific literacy, the scope of science (Lee, 1997), what counts as science, the ability to think scientifically (DeBoer, 2000), the ability to use scientific knowledge, the nature of science (Hanrahan, 1999), and knowledge about the risks and benefits of science (Shamos, 1995) can be expressed as understanding. Another definition is made by Lederman and Niess (1998). According to this definition, individuals with scientific literacy possess the following characteristics: they can effectively comprehend and apply scientific theories, concepts, laws, and processes; use scientific methods to solve personal and social issues; differentiate scientific events from personal opinions; use science and technology for the benefit of humanity; and have an understanding of the nature of science.

Motivation

Motivation refers to the drive or willingness to take action and engage in activities. Someone who takes action based on a goal is considered motivated (Ryan & Deci, 2000). In educational terms, motivation is the effect on the activation, maintenance, and control of the learning action (Chen, 2001). In other words, it is defined as all of the motives that cause intentional or unintentional behavior in the individual, and that can be controlled by the individual (Arık, 1996). A student with insufficient motivation is not ready to learn (Akbaba, 2006).

Importance of Study

Upon examining the literature, it can be observed that there are numerous studies on the context-based learning approach and STEM education in both Turkey and abroad. These studies included teachers (Akdeniz & Paniç, 2012), pre-service teachers (Özay Köse & Çam Tosun, 2010), secondary school (Sadi, 2013) and middle school (Karslı & Kara Patan, 2016) students, and the misconceptions in these studies (Karslı & Saka, 2017), motivation (Alivernini & Lucidi, 2011) and academic achievement (Güneş Koç, 2013) are considered as dependent variables.

The studies on STEM education have explored aspects, including teachers (Pilkinton, 2018), prospective teachers (Moon, 2018), secondary school students (Çevik, 2018; Olivarez, 2012), and primary school students (Tolliver, 2016). These studies have investigated topics such as interest (Pekbay, 2017), motivation (Yıldırım, 2016), attitude (Tseng et al., 2013), academic achievement (Olitsky, 2012), and scientific process skills (Gökbayrak & Karışan, 2017). In this direction, the present study aims to contribute to the literature by investigating the effects of context-based STEM activities on students' scientific literacy and STEM motivation. The research problem statement is: "Does the implementation of context-based STEM activities have an impact on the scientific literacy and motivation towards STEM among 7th-grade middle school students?" In this regard, the sub-problems of the study are expressed below. Is there a significant difference in terms of scientific literacy and STEM motivation among the corrected post-test mean scores, based on the pre-test mean scores, of Experiment-I, where context-based STEM activities were implemented, Experiment-II, where context-based activities were implemented, and the control groups where the current curriculum was implemented?

Method

In this research, a quasi-experimental design with a pre-test and post-test control group, which is one of the quantitative research methods, was used. In quasi-experimental designs, an unbiased assignment cannot be made in the formation of groups. Previously created groups are matched over certain variables. After the matching phase, the groups are randomly assigned to the processing groups (Büyüköztürk, 2013).

Research Sampling

The study group consists of three randomly selected classes in a secondary school affiliated with the MoNE. Among these classes, the science practicing course

curriculum was applied to the control group, context-based STEM activities to the experimental-I group, and context-based activities to the experiment-II group. The study was carried out with a total of 82 students, 25 in the control group, 29 in the experimental-I group, and 28 in the experimental-II group. Before the research, scientific literacy and STEM motivation scales were applied as a pre-test, and the obtained data were analyzed with ANCOVA. As a result of the analysis, it was seen that there was no significant difference between the groups in terms of scientific literacy. In terms of STEM motivation, it was determined that there was a significant difference between the experimental-II and control groups in favor of the experimental-II group.

Data Collection Tools

The scientific literacy scale and STEM motivation scale were used as data collection tools.

Scientific Literacy Scale

The scientific literacy scale was developed by Fives et al. (2014) and adapted into Turkish and Turkish culture by Şahin and Ateş (2018). In order to adapt it to Turkish culture, the scale was applied to 823 students studying in the seventh-grade, the data obtained were analyzed with confirmatory factor analysis, and as a result of the findings, it was determined that the standard goodness of fit criteria were at an accepted level. The KR-20 internal consistency coefficient of the scale was found to be .66. The highest score that can be obtained from the scale is 18. The reason for choosing this scale is that it is easy to use for students and practitioners, the items are understandable, and a validity and reliability study has been conducted for Turkey.

STEM Motivation Scale

The STEM motivation scale, originally called "Development and practicing of a scale to measure students' STEM continuing motivation," developed by Luo et al. (2019), was used to reveal students' motivation levels for STEM. The scale was developed to measure the STEM motivations of 7th and 8th-grade students (Şimşek & Hamzaoğlu, 2022). The scale consists of 25 items and is in a 4-point Likert type as never (1), rarely (2), often (3), and always (4). Two of the items in the scale are negative items. The scale consists of four sub-dimensions. These; science, technology, engineering, and mathematics dimensions. In order to determine the adaptation of the scale to Turkish culture, it was applied to 359 students studying in the 7th and 8th grades, and the data obtained were calculated by confirmatory factor analysis and EAP/PV reliability value used in item response theory. As a result of confirmatory factor analysis, it was determined that the scale was suitable for Turkish culture, and the standard goodness of fit criteria were at an acceptable level. EAP/PV values were calculated as .734 for science, .708 for technology, .803 for engineering, and .796 for mathematics and were found to be at an appropriate level (Luo et al., 2019).

Research Process

Information was given about the content prepared for the control group, the experimental-I group, and the experimental-II group, respectively, and the practices conducted during the study. The scientific literacy and STEM motivation scales were administered to the students in the control group as a pre-test after selecting the 7/G class through simple random sampling. Then, the science practice course was taught in line with the current annual program of the MoNE (2018). The methods and techniques

applied during the course were in the form of lectures, project-based learning, and discussion. The "Science Applications" courses, in which all the activities of this study were carried out, were taught in the "Science Laboratory" class at the school. Five tables were created by arranging the science laboratory class in accordance with cooperative learning. The students were divided into five groups heterogeneous within themselves but homogeneous among the groups. Each group was given a name. Considering the Covid-19 pandemic, the temperature of the students was measured, the maximum attention was paid to masks, distance, and cleaning rules, and the activities were carried out under these conditions.

During the implementation process of the research, pre-tests were conducted for the control group, and information was provided about the science practice course. Then, the science teaching program titled "Journey to Space, Constellations, Genetic Code and the Fusion of Science and Art through Dance" were sequentially implemented. Finally, the post-tests were conducted, completing the thirteen-week process. Some of the images of the control group are shown in the appendix.

Context-based REACT strategy-supported STEM activities were applied to the Experiment-I group. The activities were carried out by the researcher for 10 weeks (20 class hours), 2 hours a week, with 7/A class students selected by simple random method. After conducting pre-tests for the experiment-I group, the activities titled "designing my ship, launching my rocket, designing my cable car, constructing my roof, my floating vehicle, producing clean water" were implemented sequentially. The thirteen-week implementation was completed with the administration of post-tests. Some pictures of the experiment-I group are shown in the Appendix. An example lesson plan is shown below.

1. Relating: The teacher started the lesson with the students at their desks. After the greeting, the following questions were asked to the students.

- Have you ever been in a ship or boat-type vehicle? Please explain.
- Have you traveled by plane before? If you did or observed it in various ways, how did it look? What are its most prominent features? Please explain.
- What is the difference between a ship and a raft?

After the answers to the questions are received, the news content called school ordeal is distributed.

School Ordeal

Millions of children in the world go to school under very difficult conditions for various reasons.

One of these difficult conditions is experienced in Sootea, a small village in India. Students risk their lives every day because there is no school in their area, and the closest school to them is on the other side of the river. Because there is no access by bridge or boat on the river.

With their school bags on their backs, they line up first, then try to cross the river by getting on pots almost their size.

One of the children's teachers, J Das, said, "The students are crossing the river using aluminum pots as there are no bridges in the area." summarizes the situation.

Answer the following questions based on the news above.

a. What are the characteristics of the vehicle and vehicle the students use to cross the river?

……..……
……
b. What is the difference between the vehicle used by the students and a boat?

……
……

Then, the students are asked to read the news content inside themselves first. After the internal reading is completed, a student is read aloud. After the reading is completed, the students are asked the questions under the news content in order to make the students think about the event and to relate the water resistance and air resistance, and the students are asked to write the answers to the questions. Upon the completion of this activity, the content of the news about the plane crash is distributed to the students. Students are asked to read the relevant news, and the existence of air resistance is made to feel through the working principle of the parachute. With the news, students are made aware of the existence of water and air resistance.

2. Experiencing: This is the stage where the STEM activity is implemented. Here, students are asked to design a ship based on the events in the school ordeal story. If you were to make a vehicle that could move on water, what would its characteristics be, and how would it be seen? Please show by drawing. An equal amount of material is then given to all groups. The materials are in the form of 1 hot glue stick and gun, 2 pipettes, 20X50 cm aluminum foil, cling film, a blow dryer or fan, stopwatch, cardboard, liquid adhesive, dynamometer, 2 garbage skewers, 2 tongue sticks. Provided that the objects of the same mass are carried, the ship must cover the desired distance in the shortest possible time. Here, students are expected to design a ship with the least water resistance and the most air resistance. It will be taken into account that the weather is windy and the wind blows from north to south at a constant speed.

3. Applying: Groups are asked to introduce the products they have made in the "experiment phase." Speakers selected from the groups introduce the ships they designed. By drawing the following table on the class board, the characteristics of the ideal ship are determined by the class, and the existence and importance of water and air resistance are emphasized.

4. Cooperating: In this stage, students are given a diagnostic branched tree to work collaboratively within and between groups by applying the knowledge and concepts they have learned through STEM activities in the "experiencing" stage. In this context, students are asked to solve the questions in the worksheets that involve air and water resistance gains.

5. Transferring: In order to transfer the knowledge acquired about air resistance to different situations that students may encounter in daily life, a worksheet is distributed to them. They are asked to solve the questions individually. Several of the solutions are read aloud, and the lesson is completed.

In order to determine the effect of context-based REACT strategy activities on students in the practicing for the Experiment-II group, the 7/E branch, which was taught in the same school as the Experiment-I group, was randomly selected as the Experiment-II group. In the science practicing course, lessons were carried out with teaching supported by the context-based REACT strategy, which is one of the context-

based learning methods. The practice was implemented by the researcher for 10 weeks (20 lesson hours), 2 lesson hours per week. The planning for the implementation is shown in Table 1.

Table 1
Activities and Duration of the Experiment-II Group

Practicing time	Activities for the Experiment-II group	Time
8.09.2021	Pre-tests and giving information about the science practice course	80’
15.09.2021	I’m learning about water and air resistance	80’
22.09.2021	bow and arrow activity	80’
29.09.2021	bow and arrow activity	80’
6.10.2021	Energy and its transformations	80’
13.10.2021	Energy and its transformations	80’
20.10.2021	I’m designing a dynamometer	80’
27.10.2021	Intensity	80’
3.11.2021	Intensity	80’
10.11.2021	Can it be seen that sound is an energy?	80’
17.11.2021	1st-semester break	-
24.11.2021	Let’s separate the mixtures	80’
1.12.2021	Conducting final tests	40’

When Table 1 is examined, it is seen that the pre-test and post-tests were done in two weeks, and the practice lasted for 10 weeks. Some pictures of the experiment-II group are shown in the Appendix. An example lesson plan is presented below.

1. Relating: The following questions are asked to students to make them realize that gravitational potential energy can also be converted into kinetic energy by taking advantage of the flexibility potential energy they have learned in the previous lesson:

   -How can a bicycle go downhill without pedaling? Explain.

   -What is the effect that makes a pot on the balcony fall to the ground when it is released into the air?

   The students’ responses are evaluated, and the lesson continues. Then, the news titled “The Black Sea and Transportation” is distributed to the students, and they are encouraged to do intrinsic reading. Then, a student is asked to read the text, and the questions below the text are directed to the students. Thus, students are encouraged to think about the working principle of the cable car.

2. Experiencing: The students go to the schoolyard together. Here, two objects with the same weight are thrown onto the ground, and their sinking depths are compared. Then, two objects with different weights are thrown onto the ground again, and their sinking depths in the ground are measured. Afterwards, the

results are discussed, and a test related to energy conversion is distributed to the students.

3. Applying: In this section, students are given cable car materials that have been previously prepared, and they are given the opportunity to investigate the transformation of potential energy into kinetic energy practically. Students are expected to make inferences by observing the cable carload-carrying platform dropped from various heights.
4. Cooperating: A working sheet is given to student groups who understand energy conversion. They are asked to solve the questions by communicating within and between their own groups.
5. Transferring: In this section, energy conversion devices that have been previously designed are given to student groups to encourage observation and experimentation. They are made to understand the relationship between weight and the movement of the car in these tools. They are encouraged to make enough trials, then asked to write 5 examples related to energy conversion, and a test is distributed to end the lesson.

Data Analysis

It was decided that ANCOVA analysis would be appropriate since there was a significant difference between the groups as a result of the pre-test. Whether the data met the ANCOVA assumptions was examined. The assumptions of ANCOVA are that the variances of the scores of the dependent variables are homogeneous and the scores are normally distributed, the regression slopes within the groups are equal, and there is a linear relationship between the dependent variable and the covariate.

Levene test results were examined for the equality of one-way variances of the groups. In the data obtained, there is no significant difference in scientific literacy (F_{2-76}=.834;.p>.05) and STEM motivation (F_{2-76}=1.33; .p>.05) scales. The data obtained show that the variances regarding the test scores are homogeneous.

Shapiro-Wilk test values were examined to determine whether the groups showed a normal distribution, and the results were found to be .05<p. These data show that the dependent variable scores are normally distributed (Tabachnick & Fidell, 2001).

When the data on the homogeneity of the regression slopes within the groups were examined, it was found that the post-test scores of the scientific literacy (F_{2-76}=1.84; p>.05) and STEM motivation (F_{2-76}=.347; p>.05) scales were examined. It was determined that the group pre-test joint effect was not significant. The obtained findings show that the slopes of the regression lines belonging to the dependent variables are equal (homogeneous).

Finally, the assumption of ANCOVA test is that there is a linear relationship between the dependent variable and the covariate. Pearson Correlation test was used to reveal this relationship. It was determined that there was a significant difference between the pre-test and post-test mean scores of all groups for scientific literacy and STEM motivation variables (p< .001). The data obtained show that the scales meet the ANCOVA assumptions in the analysis.

In the analysis of the data, the effect size was checked. To calculate the effect size, the eta-square coefficient (η^2) is found. If η^2=.01-.06 is interpreted as "small," up to η^2=.06-.14 as "medium," η^2=.14 and above as large effect size (Büyüköztürk, 2014).

Findings

It will be examined whether there is a significant difference between the scientific literacy post-test mean scores of the experiment-I, in which context-based REACT strategy-supported STEM activities are applied, experiment-II in which context-based REACT strategy activities are applied, and the control group in which the current curriculum of the science practicing course is applied. In order to analyze the ANCOVA test, firstly, the pre-test score averages were determined as covariant, and the corrected average of the post-test scores was calculated. The results are shown in Table 2.

Table 2
Post-Test Mean Scores Adjusted According to the Scientific Literacy Pre-Test Mean Scores of the Groups

Group	N	$\bar{x}$	SD
Experimental-I	29	11.34	11.36
Experimental-II	28	8.71	8.69
Control	25	6.56	6.56

When Table 2 is examined, the corrected mean score of the students in the experimental-I group from the scientific literacy scale is 11.36, the students in the experimental-II group are 8.69, and the students in the control group are 6.56. ANCOVA test was used to determine whether there was a significant difference between the scores of the experimental and control groups. The results are shown in Table 3.

Table 3
ANCOVA Results for Post-Test Means Adjusted for Scientific Literacy Pre-Test Mean Scores

Source of Variance	Sum of Squares	df	Mean Squares	F	*p*	η^2
Pre-test	0.56	1	.56	.77	.770	.001
Group	311.068	2	155.534	22.06	.000	.361
Error	546.869	78	7.05			
Total	860.988	81				

When Table 3 is examined, there is a significant difference between the post-test mean scores of the groups ($F_{1\text{-}78}$=22.06; p<.05) according to the scientific literacy scale corrected pre-test mean scores. The partial eta square value, which is the calculated effect size value for the significant difference, was found to be .361. Bonferroni test was applied to determine between which groups the significant difference between the groups was. The results are shown in Table 4.

Table 4
Bonferroni Test Results Regarding the Scientific Literacy Scale Mean Scores of the Groups

Groups	Average difference between groups	Standard error	*p*
Experiment-I and experiment-II	2.67	.711	.001*
Experiment-I and control	4.8	.725	.000*
Experiment-II and control	2.13	.734	.014*

*$p<.05$

Table 4 shows that there is a significant difference between the experimental-I group, in which context-based REACT strategy-supported STEM activities were applied, and the experimental-II group, in which context-based REACT strategy activities were applied, and the control group, in which the current curriculum was applied. In addition, that there is a significant difference between the experimental-II group, in which context-based REACT strategy activities were applied, and the control group, in which the current curriculum was applied. According to these results, the context-based REACT strategy supported STEM activities applied to the experimental-I group, context-based REACT strategy activities applied to the experimental-II group, and the current curriculum applied to the control group; context-based REACT strategy activities applied to the experimental group II are more effective in improving scientific literacy than the current curriculum applied to the control group.

It will be examined whether there is a significant difference between the STEM motivation scale post-test scores of the experimental group in which context-based REACT strategy supported STEM activities were applied, experiment-II in which context-based REACT strategy activities were applied, and the control group in which the current curriculum of the science practicing course was applied. ANCOVA test will be applied to analyze the data obtained from the STEM motivation scale applied to Experiment-I, Experiment-II, and control groups. For this purpose, pre-test mean scores were determined as covariant, and the corrected mean of post-test mean scores were calculated. The results are shown in Table 5.

Table 5
Post-Test Mean Scores Adjusted According to Groups' STEM Motivation Pre-Test Mean Scores

Group	N	$\bar{x}$	SD
Experimental-I	29	81.82	81.90
Experimental-II	28	72.00	72.12
Control	25	65.28	65.04

Table 5 show that the corrected mean score of the students in the experimental-I group from the STEM motivation scale is 81.90, 72.12 in the experimental-II group, and 65.04 in the control group. ANCOVA test was used to determine whether there was a significant difference between the scores of the experimental and control groups. The results are shown in Table 6.

Table 6
ANCOVA Results for Post-test Mean Scores Adjusted for STEM Motivation Scale Pre-Test Mean Scores

Source of Variance	Sum of Squares	df	Mean Squares	F	*p*	η^2
Pre-test	19.74	1	19.74	.172	.679	.002
Group	3688.63	2	1844.32	16.08	.000	.292
Error	8945.24	78	114.68			
Total	12724.51	81				

Table 6 shows that there is a significant difference between the post-test mean scores of the groups (F_{1-78} =16.08; p= <.05) according to the STEM motivation scale, adjusted pre-test mean scores. Partial eta square value, which is the calculated effect size value for significant difference, was found to be .292 for STEM motivation.

Bonferroni test was applied to determine between which groups the significant difference between the groups was. The results are shown in Table 7.

Table 7
Bonferroni Test Results Regarding the STEM Motivation Scale Mean Scores of the Groups

Groups	Average difference between groups	Standard Error	*p*
Experiment-I and experiment-II	9.78	2.83	.010*
Experiment-I and control	16.86	3.02	.000*
Experiment-II and control	7.08	3.06	.024*

*p<.05

When Table 7 is examined, it is seen that there is a significant difference in favor of the experimental-I group between the experimental-I group, in which context-based REACT strategy supported STEM activities were applied, and the experimental-II group, in which context-based REACT strategy activities were applied, and the control group, in which the current curriculum was applied. In addition, it was determined that there was a significant difference between the experimental-II group and the control group in favor of the experimental-II group. According to these results, it is seen that the context-based REACT strategy-supported STEM activities applied to the experimental-I group are more effective on the STEM motivations of the students than the context-based REACT strategy activities and the current curriculum.

Discussion

When the findings obtained from the scientific literacy scale are examined between the experimental-I group and the experimental-II and control groups, there is a significant difference between the experimental-II group and the control group (Table-4). It has been concluded that context-based REACT strategy-supported STEM activities are more effective in terms of scientific literacy than context-based REACT strategy activities and the current curriculum. Here, the STEM activities applied to the students are more effective than both methods on the science literacy of the students. It can be said that students' efforts to produce products by planning in line with a

scientific method within the scope of a specific purpose during STEM activities affect their scientific literacy positively. As a matter of fact, students made an effort to solve personal, social, and scientific problems by using their scientific process skills during STEM activities.

Conclusion

REACT strategy and STEM education have been discussed separately since a resource about the context-based REACT strategy STEM education could not be reached in the literature. In this direction, when the studies on the REACT strategy are examined, studies showing parallelism with the current study are found (Avargil et al., 2012; Krajcik et al.,2008; Phillips & Norris, 2009). For example, in the study conducted by Keskin and Çam (2019), the effect of the REACT strategy on the academic success and scientific literacy of sixth-grade students were examined. The findings show that the REACT strategy had a positive effect on students' science literacy. These results coincide with the goal of raising scientifically literate individuals, which is one of the objectives of the REACT strategy (Leoul et al., 2006; Millar & Osborne, 1998).

The fact that Turkey's average science literacy score is below the PISA results (OECD, 2013) reveals the importance of STEM education. Because students' discovery of real-life problems in STEM education is a factor that positively affects scientific literacy. The scientific literacy levels of students who use scientific process skills and are willing to solve social problems, research and question information will be expected to increase (MEB, 2013). This situation can be justified by the fact that the mean of the experimental group I, in which the STEM application was made, was higher than the other groups.

As a result, context-based activities were applied in both groups, but STEM supported context-based learning method was more effective on students' scientific literacy. This result shows the importance of STEM education and is seen as the most important result of this study.

In line with these results, context-based REACT strategy-supported STEM activities are more effective than both context-based REACT strategy activities and the current curriculum in terms of STEM motivation.

Motivation is the individual's willingness to take action towards a specific goal. An individual who is motivated in the face of a situation does his actions willingly and is happy because of these actions (Ryan & Deci, 2000). STEM motivation is the desire of students to take action towards STEM fields and to continue this action. In light of the data on STEM motivations, it is believed that STEM activities have an important role in making a significant difference between the experimental group I and the other groups in which context-based REACT strategy-supported STEM activities were applied. Because the students did the STEM activities that they had not done before during the lesson effectively and developed materials to solve daily problems.

There are studies showing that the context-based REACT strategy, which is a type of context-based learning approach, creates a statistically significant difference in students' motivation levels (Bennett & Lubben, 2006; Campbell & Lubben, 2000; Finkelstein, 2005; Parchmann et al., 2006). Implementing the context-based REACT strategy with activities that will attract students' attention according to the current curriculum may be a factor that increases the students' motivation levels. In the research conducted by Yıldırım and Gültekin (2017), it was determined that the context-based

learning method increased the motivation of the students. In order for students' motivation towards STEM disciplines to be at the desired level, STEM activities need to be implemented in the educational process.

Context-based REACT strategy was more effective on students' motivation levels than the current program. It has been determined that STEM activities supported by the context-based REACT strategy are more effective than both the context-based REACT strategy and the current program. This result shows that STEM education effectively increases students' motivation levels in context-based REACT strategy-supported STEM activities. Because STEM education adopts an interdisciplinary approach, students produce a product as a result of the activity (Bybee, 2010), and enable students to focus on producing solutions for the problem by associating the subjects with daily life problems are the factors that increase the students' motivation.

Implications

It was observed that context-based REACT-supported STEM activities increased the averages of scientific literacy and STEM motivation in 7th-grade students. These activities can be tested at other grade levels to see if they provide similar benefits. Context-based REACT strategy-supported STEM activities can be done in different courses, and their effects can be investigated. Due to the Covid-19 global epidemic, the implementation period of this study has been limited. After this threat is gone, the effects can be investigated again by keeping the practice time longer.

Statement of Responsibility

All authors contributed to the study conception and design. First author performed material preparation, data collection and analysis. Second author wrote the first draft of the manuscript and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Conflicts of Interest

No potential conflict of interest with respect to the research, authorship, and/or publication of this article was reported by the authors. This research received no specific grant from any funding agency in the public, commercial or not-for profit sectors.

Author Bios:

Faruk ŞİMŞEK works as a science teacher at the Ministry of National Education. He received doctorate degree from Gazi University Science Education Program in 2022. The author has articles published in international and national journals and presentations in scientific meetings. The author's areas of work are STEM education, context-based learning and quantum learning. He is married and has two children.

Ergin HAMZAOĞLU is a professor in the Department of Educational Sciences at Gazi University. He works in Gazi Education Faculty, Mathematics and Science Education, Science Education. Her research areas are science learning and teaching. He is married and has four children.

References

Akbaba, S. (2006). Motivation in education. *Journal of Kazım Karabekir Education Faculty, 13*, 343-361. Retrieved from https://dergipark.org.tr/tr/pub/ataunikkefd/issue/2774/37170

Akdeniz, A., & Paniç, G. (2012). Teachers' opinions about new physics education program and its implementation. *National Education, 196,* 290-307. Retrieved from https://dergipark.org.tr/en/pub/milliegitim/issue/ 36171/406686

Akgunduz, D., Aydeniz, M., Cakmakci, G., Cavas, B., Corlu, M. S., Oner, T., & Ozdemir, S. (2015). *A report on STEM education in Turkey: A provisional agenda or a necessity?* Aydin University Publication. https://doi.org/10.13140/RG.2.1.1980.0801

Alivernini, F., & Lucidi, F. (2011). Relationship between social context, self-efficacy, motivation, academic achievement, and intention to drop out of high school: A longitudinal study. *The Journal of Educational Research*, *104*, 241-252. https://doi.org/10.1080/00220671003728062

Arık, A. (1996). *Introduction to motivation and excitement.* Çantay.

Avargil, S., Herscovitz, O., & Dori, Y. J. (2012). Teaching thinking skills in context-based learning: Teachers' challenges and assessment knowledge. *Journal of Science Education and Technology, 21*(2), 207-225. https://doi.org/10.1007/s10956-011-9302-7

Bennett, J., & Lubben, F. (2006). Context based chemistry: The salters approach. *International Journal of Science Education, 28*(9), 999-1015. https://doi.org/10.1080/09500690600702496

Brooks, J. G., & Brooks, M. G. (1993). *In search for understanding the case for constructivist classrooms*. Alexandria, Virginia: ASCD.

Büyüköztürk, Ş. (2013). *Experimental designs pretest-posttest control group designs and data analysis.* Pegem Academy

Büyüköztürk, Ş. (2014). *Data analysis handbook for social sciences: Statistics, research design, SPSS applications and interpretation*. Pegem Academy.

Bybee, R. W. (2010). What is STEM education? *Science, 329*(5995), 996-996. https://doi.org/10.1126/science.1194998

Campbell, B., & Lubben, F. (2000). Learning science through contexts: Helping pupils make sense of everyday situations. *International Journal of Science Education,* 22, 239-252. https://doi.org/10.1080/095006900289859

Chen, A. (2001). A theoretical conceptualization for motivation research in physical education: An integrated perspective. *Quest, 2*, 35-58. https://doi.org/10.1080/00336297.2001.10491729

Clark, J. N. (2010). Education in Bosnia-Herzegovina: The case for root-and-branch reform. *Journal of Human Rights, 9*(3), 344-362. https://doi.org/10.1080/14754835.2010.501269

Crawford, M. L. (2001). *Teaching contextually: Research, rationale, and techniques for improving student motivation and achievement in mathematics and science*. Texas: CCI.

Çevik, M. (2018). Impacts of the project based (PBL) science, technology, engineering and mathematics (STEM) education on academic achievement and career interests of vocational high school students. *Pegem Journal of Education and Instruction, 8*(2), 281-306. http://dx.doi.org/10.14527/pegegog.2018.012

DeBoer, G. E. (2000). Scientific literacy: Another look at its historical and contemporary meanings and its relationship to science education reform. *Journal of Research in Science Teaching, 37,* 582-601. https://doi.org/10.1002/1098-2736(200008)37:63.0.CO;2-L.

Dönmez, İ., Gülen, S., & Ayaz, M. (2022). Impact of argumentation-based stem activities on ongoing STEM motivation. *Journal for STEM Educ Res, 5*, 78–101. https://doi.org/10.1007/s41979-021-00062-2

Dugger, W. E. (2010, December). *Evolution of STEM in the United States*. Presented at the 6th biennial international conference on technology education research, Gold Coast, and Queensland.

Finkelstein, N. D. (2005). Learning physics in context: A study of student learning about electricity and magnetism. *International Journal of Science Education, 27*(10), 1187-1209. https://doi.org/10.1080/09500690500069491

Friedman, T. (2007). *The world is flat: A brief history of the twenty-first century*. New York: Farrar, Straus and Giroux.

Geng, J., Jong, M.S.Y., & Chai, C. S. (2019). Hong Kong teachers' self-efficacy and concerns about STEM education. *The Asia-Pacific Education Researcher, 28*(1), 35-45. https://doi.org/10.1007/s40299-018-0414-1

Gilbert, J. K., Bulte, A. M., & Pilot, A. (2011). Concept development and transfer in context-based science education. *International Journal of Science Education, 33*(6), 817-837. https://doi.org/10.1080/09500693.2010.493185

Glynn, S. M., & Winter, L. K. (2004). Contextual teaching and learning of science in elementary schools. *Journal of Elementary Science Education, 16*(2), 51-63. https://doi.org/10.1007/BF03173645

Glynn, S., & Koballa, T.R. (2005). The contextual teaching and learning instructional approach. *In R. E. Yager (Ed.), Exemplary science: Best practices in professional development (pp. 75-84).* Arlington, Va: National Science Teachers Association.

Gökbayrak, S., & Karışan, D. (2017). An investigation of the effects of STEM based activities on preservice science teacher's science process skills. *Western Anatolia Journal of Educational Sciences, 8*(2), 63-84. Retrieved from https://dergipark.org.tr/tr/pub/baebd/issue/33149/347724

Güneş Koç, R. S. (2013). *The effect of context based approach supported by 5E learning model on 7th grade students' achievements, retention and attitude on the unit "light"* [Unpublished doctoral dissertation]. Gazi University, Turkey.

Hacıoğlu, Y., Yamak, H., & Kavak, N. (2016). Teachers' opinions regarding engineering design based science education. *Bartın University Journal of Faculty of Education, 5*(3), 807-830. https://doi.org/10.14686/buefad.v5i3.5000195411

Hanrahan, M. (1999). Rethinking science literacy: Enhancing communication and participation in school science through affirmational dialogue journal writing. *Journal of Research in Science Teaching, 36,* 699-717.

https://doi.org/10.1002/(SICI)1098-2736(199908)36:6<699::AID-TEA7>3.0.CO;2-P

Hull, D. (1999). *Teaching mathematics contextually: The cornerstone of tech prep*. Texas: CORD Communication, Inc.

Iwuanyanwu, P. N. (2019). What we teach in science, and what learners learn: A gap that needs bridging. *Pedagogical Research, 4*(2), 1-12. https://doi.org/10.29333/pr/5780

Kadijevich, D. M. (2019). Influence of TIMSS research on the mathematics curriculum in Serbia: Educational standards in primary education. *The Teaching of Mathematics, XXII*(1), 33-41. Retrieved from http://elib.mi.sanu.ac.rs/files/journals/tm/42/tmn42p33-41.pdf

Karamustafaoğlu, O., & Tutar, M. (2020). Prospective science teachers' opinions on the use of REACT strategy in teaching. *Academia Journal of Educational Research, 5*(1), 1-12. Retrieved from https://dergipark.org.tr/tr/pub/egitim/issue/53591/644452

Karslı, F., & Kara Patan, K. (2016). Effects of the context-based approach on students' conceptual understanding: "The umbra, the solar eclipse and the lunar eclipse". *Journal of Baltic Science Education, 15*(2), 246-260. https://doi.org/10.33225/jbse/16.15.246

Karslı, F., & Saka, Ü. (2017). The effect of the context-based approach on 5th grade students' conceptual understanding about "getting to know foods". *Elementary Education Online, 16*(3), 900-916. https://doi.org/10.17051/ilkonline.2017.330230

Krajcik, J., McNeill, K.L., & Reiser, B.J. (2008). Learning-goals-driven design model: Developing curriculum materials that align with national standards and incorporate project-based pedagogy. *Sci Educ 92*, 1-32. https://doi.org/10.1002/sce.20240

Lacey, T. A., & Wright, B. (2009). Employment outlook: 2008-18: Occupational employment projections to 2018. *Monthly Labor Review, 132*, 82–123. https://doi.org/10.1073/pnas.0703993104

Lederman, N. G., & Niess, M. (1998). Survival of the fittest. *School Science and Mathematics, 98*(4), 169-172. https://doi.org/10.1111/j.1949-8594.1998.tb17412.x

Lee, O. (1997). Scientific literacy for all: What is it, and how can we achieve it? *Journal of Research in Science Teaching, 34*, 219-222. https://doi.org/10.1002/(SICI)1098-2736(199703)34:3<219::AID-TEA1>3.0.CO;2-V

Leoul, M., Abder, P., Riordan, M., & Zoller, U. (2006). Using 'HOCS centered learning as a pathway to promote science teachers' metacognitive development. *Res Sci Educ*, 36,69-84. https://doi.org/10.1007/s11165-005-3916-9

Li, Y. (2014). International journal of STEM education-a platform to promote STEM education and research worldwide. *International Journal of STEM Education, 1*, 1. https://doi.org/10.1186/2196-7822-1-1

Luo, T., Wang, J., Liu, X., & Zhou, J. (2019). Development and application of a scale to measure students' STEM continuing motivation. *International Journal of Science Education, 41*(14), 1885-1904. https://doi.org/10.1080/09500693.2019.1647472

Marginson, S., Tytler, R., Freeman, B., & Roberts, K. (2013). *STEM: Country comparisons: International comparisons of science, technology, engineering and mathematics (STEM) education. Final report.* Melbourne: Australian Council of Learned Academies.

Millar, R., & Osborne, J. F. (1998). *Beyond 2000: Science education for the future*. London: Nuffield Foundation.

Ministry of National Education [MoNE]. (2018). Science course curriculum. Ministry of National Education. Retrieved from http://mufredat.meb.gov.tr/ProgramDetay.aspx?PID=325

Moon, K. K. (2018). Examining the relationships between diversity and work behaviors in US federal agencies: Does inclusive management make a difference? *Review of Public Personnel Administration*, *38*(2), 218-247. https://doi.org/10.1177 /0734371X16660157

Moore, T. J., Stohlmann, M. S., Wang, H. H., Tank, K. M., Glancy, A. W., & Roehrig, G. H. (2014). Implementation and integration of engineering in K-12 STEM education. In *Engineering in pre-college settings: Synthesizing research, policy, and practices* (pp. 35-60). Purdue University Press. https://doi.org/10.2307/j.ctt6wq7bh.7

Patro, E.T. (2008). Teaching aerobic cell respiration using the 5 Es. *The American Biology Teacher, 70*(2), 85-87. https://doi.org/10.2307/30163209

Pilkinton, K. (2018). *STEM teacher education an evaluation study* [Doctoral Dissertation]. University of Southern California, USA.

Rezaei, A. R., & Katz, L. (2002). Using computer assisted instruction to compare the ınventive model and the radical constructivist approach to teaching physics. *Journal of Science Education and Technology, 11*(4), 367-380. https://doi.org/10.1023/ A:1020894002232

Olivarez, N. (2012). *The impact of a STEM program on academic achievement of eighth grade students in a south Texas middle school* [Doctoral dissertation]. Texas A&M University, ABD.

Organisation for Economic Co-operation and Development [OECD]. (2013). *PISA 2012 Results: What students know and can do-student performance in mathematics, reading and science (Volume I).* PISA: OECD.

Osborne, J., & Collins, S. (2001). Pupils' views of the role and value of the science curriculum. *International Journal of Science Education, 23*(5), 441-467. https://doi.org/10.1080/09500690010006518

Olitsky, N. H. (2012). How do academic achievement and gender affect the earnings of STEM majors? A propensity score matching approach. *Res High Educ*, *55*, 245-271. https://doi.org/10.1007/s11162-013-9310-y

Özay Köse, E., & Çam Tosun, F. (2010). Effect of "context-based learning" in students' achievement about nervous system. *Journal of Turkish Science Education, 8*(2), 91-106. Retrieved from https://www.tused.org/index.php/tused/article/view/570

Özbilen, A. (2018). Teacher opinions and awareness about STEM education. *Scientific Educational Studies, 2*(1), 1-21. Retrieved from https://dergipark.org.tr/tr/pub/ses/issue/37465/414916

Özcan, H., & Koştur, H. İ. (2019). The investigations of science curriculum acquisitions in terms of special purposes and field-specific skills. *Trakya Journal of Education, 9*(1), 138-151. https://doi.org/10.24315/tred.469584

Parchmanna, İ., Gräselb, C., Baerc, A., Nentwigc, P., Demuthc, R., & Ralled, B. (2006). The chik project group chemie im kontext: A symbiotic implementation of a context-based teaching and learning approach. *International Journal of Science Education, 28*(9), 1041-1062. https://doi.org/10.1080/09500690600702512

Pekbay, C. (2017). *Effects of science technology engineering and mathematics activities on middle school students* [Unpublished doctoral dissertation]. Hacettepe University, Turkey.

Phillips, L.M., & Norris, S.P. (2009). Bridging the gap between the language of science and the language of school science through the use of adapted primary literature. *Res Sci Educ, 39,* 313-319. https://doi.org/10.1007/s11165-008-9111-z

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology*, *25*(1), 54-67. https://doi.org/10.1006/ceps.1999.1020

Sadi, S. (2013). *The effects of the context- based learning approach on the training of chemical changes unit* [Unpublished doctoral dissertation]. Atatürk University, Turkey.

Sanders, M. (2009). STEM, STEM education, STEMmania. *The Technology Teacher, 68*(4), 20-26. Retrieved from http://hdl.handle.net/10919/51616

Shamos, M. (1995). *The myth of scientific literacy*. New Brunswick, NJ: Rutgers University.

Stinner, A. (2006). The large context problem (LCP) approach. *Interchange*, *37*(1-2), 19-30. https://doi.org/10.1007/s10780-006-8398-9

Şahin, F., & Ateş, S. (2018). Adaptation of the scientific literacy scale developed for middle school students. *Gazi University Journal of Gazi Educational Faculty, 38*(3), 1173-1205. https://doi.org/10.17152/gefad.406601

Şimşek, F., & Hamzaoğlu, E. (2022). Adaptation of the STEM activities motivation scale for 7th and 8th grade students. *Journal of Research in Education and Society, 9*(1), 55-65. https://doi.org/10.51725/etad.1025884

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics*. Pearson.

Thomas, T. A., (2014). *Elementary teachers' receptivity to integrated science, technology, engineering, and mathematics (STEM) education in the elementary grades* [Doctoral dissertation]. University of Nevada, ABD.

Tolliver, E. R. (2016). *The effects of science, technology, engineering and mathematics (STEM) education on elementary student achievement in urban schools* [Doctoral dissertation]. Grand Canyon University, ABD.

Topuz, F., Gençer, S., Bacanak, A. & Karamustafaoğlu, O. (2013). Science and technology teachers' views about context-based approach and the applying levels. *Amasya Education Journal, 2*(1), 240-261. Retrieved from https://dergipark.org.tr/tr/pub/amauefd/issue/1728/21195

Tseng, K. H., Chang, C. C., Lou, S. J., & Chen, W. P. (2013). Attitudes towards science, technology, engineering and mathematics (STEM) in a project-based learning (PjBL) environment. *International Journal of Technology and Design Education, 23,* 87-102. http://dx.doi.org/10.1007/s10798-011-9160-x

Ültay, N., & Çalık, M. (2011). Distinguishing 5E model from REACT strategy: An example of 'Acids and Bases' topic. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education, 5*(2), 199-220. Retrieved from https://dergipark.org.tr/tr/pub/balikesirnef/issue/3373/46559

Yıldırım, B. (2016). *An Examination of the effects of science, technology, engineering, mathematics (STEM) applications and mastery learning integrated into the 7th grade science course* [Unpublished doctoral dissertation]. Gazi University, Turkey.

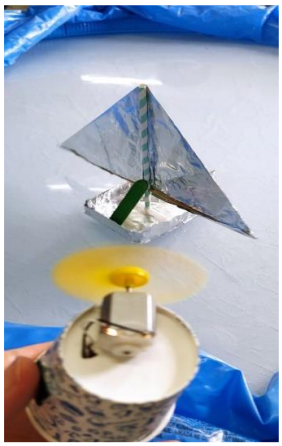
Yiğit, M. (2015). *The effect of materials prepared according to the react strategy of context based learning approach to the conceptual changing of 12th grade students in the subject of hydrocarbons* [Unpublished Master Thesis]. Giresun University Turkey.

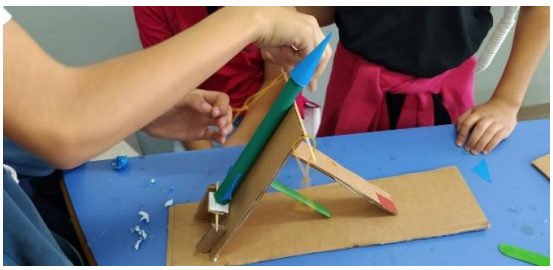
Yıldırım, P. (2017). A qualitative study on integration of science, technology, engineering, and mathematics (STEM). *Journal of Kazım Karabekir Education Faculty,* 35, 31-55. Retrieved from https://dergipark.org.tr/tr/pub/ataunikkefd/issue/33367/351798

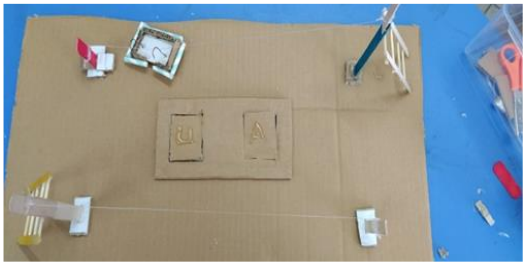
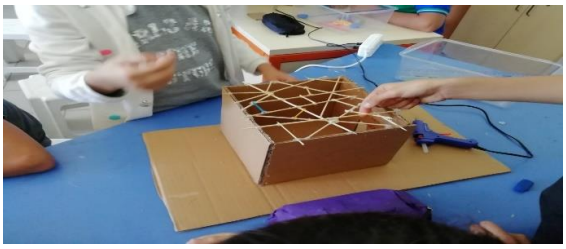
Appendix 1. Sample Photos

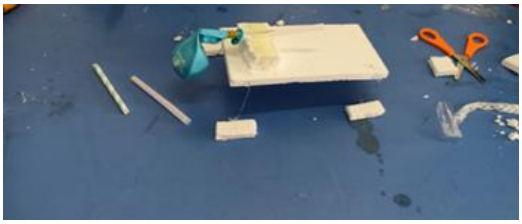
Pictures

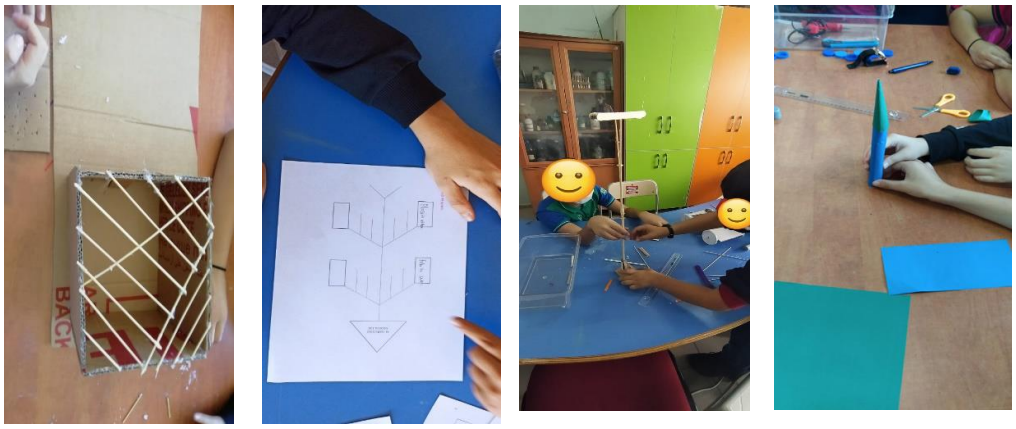
Sample Photos of the Activities in the Experimental-I Group

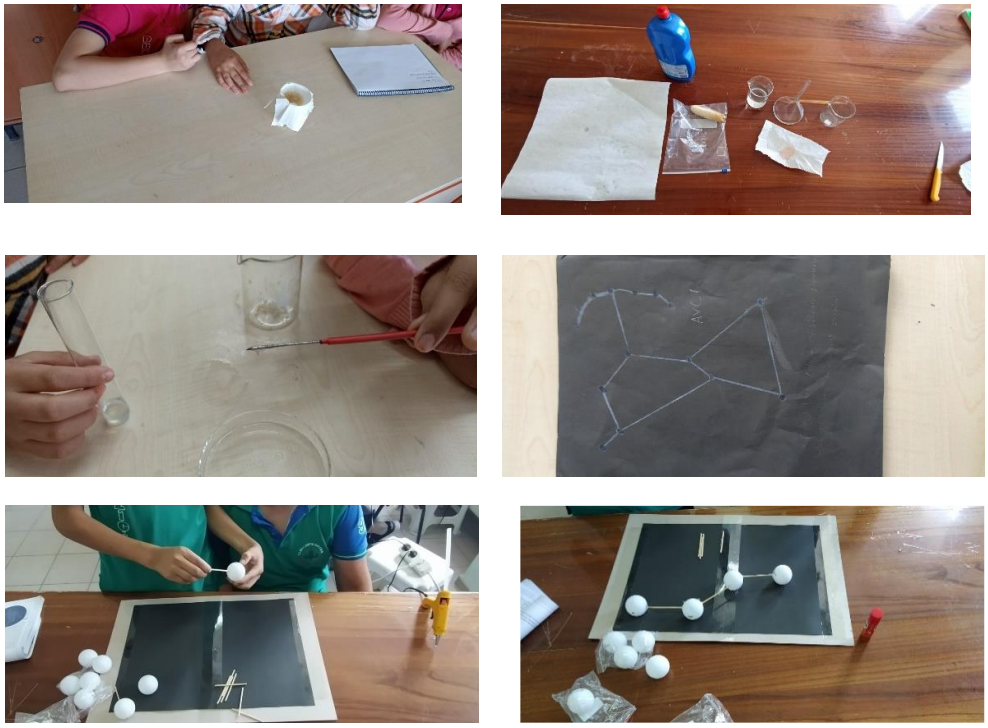






Sample Photos of the Activities in the Experimental-II Group

Sample Photos of the Activities in the Control Group



Journal of Theoretical Educational Science, 16(3), 596-616, July 2023
Kuramsal Eğitimbilim Dergisi, 16(3), 596-616, Temmuz 2023
[Online]: http://dergipark.org.tr/akukeg
DOI number: http://doi.org/10.30831/akukeg.1216428

Prospective Mathematics Teachers' Task Modifications Utilizing Their Knowledge of Pattern Generalization

Matematik Öğretmen Adaylarının Örüntü Genellemesi Bilgilerini Kullanarak Yaptıkları Etkinlik Değişiklikleri

Dilek GİRİT YILDIZ*

Received: 8 December 2023 **Research Article** **Accepted:** 23 May 2023

ABSTRACT: The purpose of the study is to evaluate how prospective mathematics teachers (PMTs) modify tasks to facilitate students' learning of pattern generalization through the use of their mathematical knowledge for teaching. Case study, which is a type of qualitative research method, was used to determine the mathematical characteristics that PMTs use when modifying a mathematical task. The knowledge from which PMTs draw to modify the task has also been outlined. Accordingly, data were collected from PMTs' task modifications and reflection reports. When PMTs worked on two or more forms of modification, as compared to just using one type of modification, they modified tasks more effectively and comprehensively. The PMTs who make condition modifications need to utilize specialized content knowledge through the use of models or tables. They aimed to help middle school students understand using these modifications, and thus they also utilized their knowledge of content and students. They also used their knowledge of content and teaching, especially while making modifications to questions and context. Task modification activities can be used to help prospective teachers notice the mathematical and pedagogical affordances and limitations offered by tasks.

Keywords: Task modification, pattern generalization, prospective mathematics teachers, mathematical knowledge for teaching.

ÖZ: Bu çalışmanın amacı, öğrencilerin örüntü genellemelerine yardımcı olmak için matematik öğretmen adaylarının matematik öğretimi bilgilerini kullanarak yaptıkları etkinlik değişikliklerini değerlendirmektir. Öğretmen adaylarının matematiksel bir etkinliği değiştirirken kullandıkları matematiksel özellikleri belirlemek için nitel araştırma yöntemlerinden durum çalışması kullanılmıştır. Ayrıca öğretmen adaylarının etkinliği değiştirirken kullandıkları bilgileri belirlenmiştir. Veriler, öğretmen adaylarının değiştirdiği etkinliklerden ve yansıtma raporlarından toplanmıştır. Öğretmen adayları, etkinlik üzerinde yalnızca bir tür değişiklik yapmaya kıyasla iki veya daha fazla değişiklik türünü birlikte yaptıklarında, etkinliklerini daha anlamlı ve kapsamlı bir şekilde değiştirmişlerdir. Koşul değişiklikleri yapanlar, model veya tablo ekleyerek uzmanlık alan bilgilerini kullanmıştır. Bu değişiklikleri öğrencilerin anlamasına yardımcı olmak amacıyla da yapmışlar ve böylece öğrenci ve alan bilgilerini de kullanmışlardır. Ayrıca öğretmen adayları, alan ve öğretme bilgilerinden özellikle soru ve bağlam değişikliği yaparken yararlanmıştır. Etkinlik değiştirme çalışmaları, öğretmen adaylarının etkinliklerin sunduğu matematiksel ve pedagojik olanakları ve sınırlılıkları fark etmelerine yardımcı olmak için kullanılabilir.

Anahtar kelimeler: Etkinlik değişikliği, örüntü genelleme, matematik öğretmen adayları, matematik öğretim bilgisi.

* Dr., Trakya University, Edirne, Türkiye, dilekgirit@trakya.edu.tr, https://orcid.org/ 0000-0003-3406-075X

Citation Information
Girit Yıldız, D. (2023). Prospective Mathematics Teachers' Task Modifications Utilizing Their Knowledge of Pattern Generalization. *Kuramsal Eğitimbilim Dergisi [Journal of Theoretical Educational Science], 16*(3), 596-616.

ISSN: 1308-1659

Several prior studies have indicated that mathematical tasks play an essential role in the teaching and learning of mathematics (e.g., Ayalon et al., 2021; Chapman, 2013; Doyle, 1983; Henningsen & Stein, 1997; Kusaeri et al., 2022; Thanheiser, 2015). A task is part of a mathematics class activity that helps students learn about a particular mathematical idea and might involve several linked problems or a challenging problem in a class session (Stein & Smith, 1998). Likewise, Doyle (1983) explains that a task is any issue or activity that assists in the development of a concept or ability within the setting of a mathematics classroom.

There is a link between the level of thinking a mathematical task requires and how well students understand mathematics. Stein and Smith (1998) assert that the types of mathematical tasks affect how students learn to think mathematically. When students are asked to follow a memorized procedure in a routine manner, they are provided with one type of thinking opportunity. When students are asked to think conceptually and make connections, they are given a different set of opportunities to think (Stein & Smith, 1998; Stein et al., 2000). Students are expected to take an active role in these tasks, assume responsibility for their outcomes, get experience with various tools and resources, and ultimately complete a product as a consequence of their efforts (Henningsen & Stein, 1997; Swan, 2008).

Stein and Smith (1998) define the Mathematics Task Framework as involving three phases that tasks follow: first, as tasks appear in textbooks, supplementary materials, and so on, second, as they are set up or presented by the teacher, and third, as students in the classroom implement them. Teachers' aims, mathematical knowledge, and knowledge of students' understanding might influence how they design tasks (Henningsen & Stein, 1997). Teachers' content and pedagogical competence can positively affect students' mathematics learning. Teacher education must address teachers' ability to modify and design relevant tasks (Lee et al., 2017; Watson & Mason, 2007). Within the scope of our investigation, our primary focus was on the second phase of the framework by Stein and Smith (1998), which pertains to teachers. Hence, the purpose of this study is to determine the mathematical characteristics that prospective mathematics teachers (PMTs) use while modifying a mathematical task in textbooks. Accordingly, the mathematical knowledge used by PMTs to modify the task is defined.

The Background of the Study

Teachers' Competencies for Task Modification

Arbaugh and Brown (2005) state that tasks have an effect on how mathematics is learned. Therefore, it is important for teachers to understand how tasks work. Accordingly, Ball (2000) states, "Acquiring the ability to think with precision about mathematical tasks and their use in class can equip teachers with more developed skills in the ways they select, modify, and enact mathematical tasks with their students" (p. xii). For example, Zaslavsky (2008) observed changes in mathematics teaching and learning after task modification. The study's findings suggest that being aware of learning opportunities while analyzing and modifying tasks enhances mathematics teaching and learning. Likewise, teachers improve their mathematics knowledge and their ability to construct lessons that use mathematics by working with, modifying, and appropriating tasks (Pepin, 2015).

According to a growing body of literature, teachers need to understand the characteristics of mathematical tasks and choose tasks that are well-suited to the learning goals (e.g., Arbaugh & Brown, 2005; Ball, 2000; Liljedahl et al., 2007). Therefore, professional development based on task analysis assists teachers in identifying the affordances and limitations of tasks (Johnson et al., 2016; Son & Kim, 2015). For example, Stephens (2006) and Papatistodemou et al. (2014) studied pre-service teachers' perceptions about the potential for mathematical concept growth in tasks. However, research indicates that pre-service teachers are ignorant of the capacity of activities to increase mathematical engagement and the growth of mathematical concepts. Teachers must comprehend the affordances and limitations of tasks in relation to student inquiry to recognize the need for task modification (Lee et al., 2019). Similarly, Liljedahl et al. (2007) noted that tasks may be adapted more effectively if both mathematical and pedagogical factors are considered. Sullivan and Mousley (2001) believe that teacher professional development should help teachers comprehend the dynamics of classroom decision-making about tasks.

Task analysis and modification are linked, and teachers can change mathematical tasks by understanding pedagogical and mathematical affordances and limits (Lee et al., 2019). Lee et al. (2016) aimed to discover tendencies that Korean prospective mathematics teachers adopt while modifying textbook tasks. Their study categorized prospective teachers' task modifications as context, condition, and question. Context adjustment involves making tasks more student-friendly (familiar contexts to students' experiences) or differentiated. Adding, eliminating, or changing task conditions is condition modification. Prestage and Perks (2007) suggested that changing the conditions of closed problems can improve students' mathematical thinking. When conditions in problems are removed, students can create particular criteria according to their own thinking. When circumstances are included, students may practice problem-solving. It is similar to Brown and Walter's (1990) "what-if-not" techniques, which involve manipulating a problem's circumstances to pose a new one. Changing what students must respond to is called question modification. Crespo (2003) mentions that prospective teachers initially focus on the students' enthusiasm and offer simple problems in her study but gradually turn their focus to the students' misunderstandings and pose problems with increased cognitive demands. Consequently, she suggests transforming the task into an open-form or investigative one with question types.

Different tasks offer various learning opportunities; thus, textbook tasks must be modified or new tasks designed to satisfy desired goals or curricular requirements (Lee et al., 2019). In addition, task modification activities support prospective teachers' learning and teaching skills. Lee et al. (2017) showed how important it was to change textbook tasks in order to support prospective teachers' creativity. Thompson (2012) and Kaur and Lam (2012) also proposed modifying tasks to incorporate reasoning and communication skills, and they used conjectures to evoke mathematical exploration. For example, Lee et al. (2019) implied that pre-service teachers' growing ability to notice student thinking is related to their growing comprehension of the mathematical and pedagogical components of tasks, and this growth has an impact on how they modify problems.

The tasks are put into action in the classroom by the teachers as well as the students through their interpretations and performances. The teacher shapes the task and

directs students' efforts so they can participate meaningfully in mathematics. There are a number of variables that might affect this process, such as teachers' content knowledge, their knowledge of students, task objectives, instructional disposition, and beliefs. The teacher's mathematical-task knowledge for instruction will determine how they handle tasks (Chapman, 2013). In a similar vein, Henningsen and Stein (1997) studied classroom characteristics that encourage or discourage high-level mathematical thinking and reasoning. According to their framework, teachers' aims, topic content expertise, and knowledge of students influence task arrangement. Accordingly, a teacher can enhance or reduce a task's cognitive demand. For example, Sullivan et al. (2010) studied the relationship between task, teacher, and student learning. Two teachers who lacked confidence in their mathematical skills made the problems basic and discouraged students' diverse answers, reducing the learning potential of the activities. Boston (2013) found that knowing task cognitive demands might help teachers enhance their knowledge and instructional practices, which have characteristics connected to increased student learning. Guberman and Leikin (2013) asserted that the experience with multiple solution tasks would likely make prospective teachers aware of the nature and significance of such tasks in their instruction. This awareness can be achieved by assessing the level of interest and difficulty of the mathematical problems.

Pattern Generalization

In algebra, the generalization of patterns for the transition from arithmetic to algebra is critical (English & Warren, 1998). Students can begin to develop algebraic thinking as early as their elementary school years (Doerfler, 2008; Radford, 2008). One of the ways to strengthen students' algebraic thinking is by generalizing different types of patterns in successions of figures or numbers or a combination of both (English & Warren, 1998). According to Radford (2008), generalization requires recognizing a pattern, expanding that pattern to include all sequence terms, and establishing a rule that can be used to identify any term of the pattern.

Callejo and Zapatera (2017) examined pre-service teachers' descriptions and interpretations of students' responses to pattern generalization questions to evaluate their ability to notice students' understanding of pattern generalization. They proposed three mathematical elements related to the pattern generalization procedure: in the first element, it is assumed that the students continued the pattern (near generalization, Radford, 2011) but were unable to associate the numerical and figural features; the second element is related to the students' ability to make connections with numerical and figural features and generalize the relationship verbally or algebraically (functional relationship) (Smith, 2008); and the third element is the reverse operation, which determines the position of the pattern. For the first element, students use recursive thinking to understand the relationship in the pattern by concentrating on the difference between subsequent output values. Then, they are required to apply the recursive strategy to the explicit rule (Healy & Hoyles, 1999; Lannin et al., 2006). To identify the explicit rule, it is important to define the functional relationship between a figure's location and the number of elements it contains (Rivera, 2010; Warren, 2000). In addition, generalization is facilitated by students' ability to identify links between input-output values of patterns through the use of visual aids such as diagrams, tables, spreadsheets, and figures (figural patterns) (Steele & Johanning, 2004; Warren &

Cooper, 2008). Students employ figural and numerical reasoning in addition to these representations to generalize patterns algebraically (Walkowiak, 2014). Students' use of the numerical method relies on numerical information obtained from several examples of the pattern. In the figural method, learning is centered on the students' ability to recognize and articulate the underlying patterns and relationships they observe in the given figures (Lee & Lee, 2021).

Mathematical Knowledge for Teaching (MKT)

In particular to mathematics teaching, the mathematical knowledge for teaching (MKT) model by Ball et al. (2008) is utilized in this study. They defined MKT as "the mathematical knowledge needed to carry out the task of teaching (p. 395)". The categories of MKT include Subject Matter Knowledge (SMK) and Pedagogical Content Knowledge (PCK). One of the components of SMK, Common Content Knowledge (CCK), refers to the mathematical knowledge utilized by individuals working with mathematics. With this understanding, teachers are able to appropriately solve problems and apply mathematical language and notations. Specialized Content Knowledge (SCK) refers to the mathematics-specific knowledge that mathematics instructors should possess. It is beyond conceptual understanding. This knowledge is utilized by educators for instructional objectives. The teacher must grasp both the conceptual structure and the visual features of the mathematical topic for the learner to comprehend it. The Knowledge of Content and Student Knowledge (KCS) component of PCK relates to the teachers' planning of mathematics-specific lessons that take into consideration the students' thinking, interest, level, difficulties, misconceptions, and prior knowledge. The second component of PCK, Knowledge of Content and Teaching Knowledge (KCT), needs instructors to be able to make teaching decisions, arrange subjects for instruction, select examples, and evaluate the efficacy of models and representations. The third component of PCK, Knowledge of Content and Curriculum (KCC), is concerned with organizing subjects in accordance with the curriculum, including activities and explanations given by the curriculum.

Significance

The current research aims to contribute to mathematics education through PMTs' task modification skills in two significant ways. First, it appears that providing opportunities for prospective teachers in teacher training to make critical analyses and revisions to the tasks supplied in textbooks is extremely significant (Cheng et al., 2021; Lee et al., 2016). One of the most important sources of instructional tasks that teachers use to shape student learning is mathematics textbooks (Cheng et al., 2021; Haggarty & Pepin, 2002; Kaur & Lam, 2012; Thomson & Fleming, 2004). Although inquiry-based education is specifically promoted in mathematics curriculums, many tasks in school mathematics textbooks allow students to achieve accurate answers by applying processes or algorithms (Basyal et al., 2023; Hidayah & Forgasz, 2020; Ubuz et al., 2010). Therefore, teachers must be able to utilize appropriate instructional tasks by designing new tasks or modifying old tasks in consideration of curricular requirements (Lee et al., 2019). Thus, this study intended to provide opportunities for recognizing the importance of tasks in mathematics teaching to PMTs through task modification.

Additionally, understanding how prospective teachers modify tasks and apply their knowledge may aid teacher educators in developing tools that assist prospective teachers in creating tasks (Lee et al., 2016). Because it is important for prospective teachers to put their knowledge into practice (Llinares & Krainer, 2006), one of the ways that is done is by engaging with tasks (Callejo & Zapatera, 2017). Recent studies have shown that teacher knowledge may have either a positive or negative impact on students' learning throughout the task design and modification phases (e.g., Sullivan et al., 2009; Stein & Smith, 1998; Swan, 2008). In particular, the design of a task by a teacher is influenced by the teacher's goal, knowledge of the topic to be addressed, and knowledge of the student (Sullivan et al., 2009). Thus, for the second contribution to mathematics education literature, it is expected that this study will reveal how PMTs apply their knowledge of algebra to modifying tasks.

In light of the fact that teachers build the students' algebraic understanding in the early grades, they play a crucial role in the teaching of algebra (Malara & Navarra, 2009). Students start to utilize algebraic symbols and notations as they learn about generalizing patterns in school algebra. As a result, pattern generalization is crucial since it marks the start of formal algebra and can help students comprehend the idea of variables. Generalizing patterns also introduces the concept of functional thinking with input-output linkages (Hoyles et al., 1999). Hence, the purpose of the study is to evaluate how teachers modify tasks to facilitate students' learning of pattern generalization through the use of their knowledge. Thus, the following research question is addressed: What characteristics of the task are changed by PMTs utilizing their knowledge to help students' pattern generalization?

Method

In this study, the qualitative research method was used to determine the mathematical characteristics that PMTs use when modifying a mathematical task from a textbook. In light of this, the knowledge that PMTs draw from in order to modify the task has been outlined. Case study, one of the qualitative research approaches, was applied in particular. Case studies are used to figure out the details of a situation, come up with possible explanations for a situation, and look deeply at a situation to determine the what, how, and why of the study's subject matter (Yıldırım & Şimşek, 2013). In the present study, the specific context/situation was PMTs' modification of the task associated with pattern generalization, and it was investigated through the case study how the interactions were between PMTs' modified tasks and knowledge utilization.

Participants

This study was conducted with 36 (29 females and seven males) fourth-grade PMTs who attended the "Task Design in Mathematics Education" course at a state university as part of the Elementary School Mathematics Teacher Training Program in Turkey. Participation in this study was voluntary. We also obtained consent forms from PMTs. The participants studied design principles for mathematical tasks, the implementation of tasks in the classroom, and the evaluation of students' thinking process in task-based instruction as part of the course. The participants also attended the majority of teaching-related courses (e.g., algebra teaching, mathematics textbook evaluation) in previous semesters. Within the algebra teaching course, participants were exposed to teaching methods and strategies pertaining to pattern generalization in the

field of algebra learning. In order to obtain precise information from PMTs, it was taken into consideration that they had specifically taken this course. Thus, the participants were selected for a specific reason using purposeful sampling (Merriam, 2009).

Data Collection and Analysis

The data gathering instrument is a task for pattern generalization. When provided to PMTs, the numbers of the pattern in the textbook were merely altered (see Figure 1). To encourage students' study of pattern generalization, the participants were asked to modify the task. In addition, they were required to write a reflection report that explains how and why they modified this task.

Figure 1

The Task

"Let's find the general rule of the 6, 10, 14, 18... pattern."

- Modify the above task to promote student exploration and engagement.
- Provide justifications for each of the modifications you have made.

Based on the study by Lee et al. (2016), the task modifications of PMTs were divided into three different categories: context, condition, and question. The descriptions for Lee et al.'s (2016) classifications were adapted specifically to pattern generalization for this study. Thus, the descriptions in this study are as follows: Condition modification is including multiple representations, such as figures and/or tables, to help students understand the task. Context modification is incorporating materials or contexts relevant to students' real-world experiences. Question modification is the act of posing or adding new questions to the task. PMTs used only one modification type (only question and only context) or two to three modification types together. Thus, three combined categories emerged: condition and question modifications, context and question modifications, and context-condition-question modifications. For example, PMT1 added a figure and a table that presented the relationship of the pattern in modifying the task (condition modification), and she also added questions that prompted students to identify a general rule (question modification) (see Figure 3). Thus, she used two types of modifications, and we categorized her attempts as condition and question modifications.

In order to code the textual assertions of PMTs, the data from the reflection reports were classified and grouped into idea units. The data unit analysis included a significant comment, explanation, paragraph, or example (Strauss & Corbin, 1998). The extracted units were then categorized according to Ball et al.'s (2008) Mathematical Knowledge for Teaching model. 'We developed definitions for the categories (SMK, KCS, and KCT) based on Ball et al.'s (2008) descriptions and also the literature-related pattern generalization (e.g., Callejo & Zapatera, 2017; English & Warren, 1998; Healy & Hoyles, 1999; Radford, 2008; Smith, 2008; Steele & Johanning, 2004; Walkowiak, 2014). Table 1 shows the definitions and examples:

Table 1

The Categories with Definitions for Pattern Generalization and Examples

Categories	Definitions	Examples
SCK	The knowledge to use a figure and a table to represent the relationship of the pattern	using squares within a figural pattern; utilizing table with position number, term, and the relationship
KCS	The knowledge of students' understanding, misconceptions, and difficulties	assisting students in understanding the concept of pattern generalization; student's thinking successively between terms; student's getting a general rule algebraically
KCT	The knowledge to organize the questions for making students think inductively or need a general rule; The knowledge of context-based instruction	asking the values of far terms to allow finding a general rule; using the numbers of pages in the context of reading books from students' daily lives

In this study, the researcher and an expert in mathematics education research individually coded the data for cross-checking. There is a 91% match in our independent coding. We discussed the controversial codes and their meanings until we reached a complete agreement.

Ethical Procedures

The fact that the research does not pose an ethical problem has been confirmed by the ethics committee report issued 367596 and dated 30.11.2022 received from the Human Research Ethics Committee of Trakya University.

Before starting the implementation, the participants were informed about the research. They participated in the study voluntarily. The names of participants were reported using codes in accordance with ethical rules.

Findings

The PMTs' task modifications are divided into three main categories: context modification, condition modification, and question modification. It was observed that most PMTs made two modifications at the same time (see Figure 2). The questions were also changed, particularly when the context or condition was modified. In addition, there were PMTs who performed all three modifications.

Figure 2

Frequency of Task Modification Types

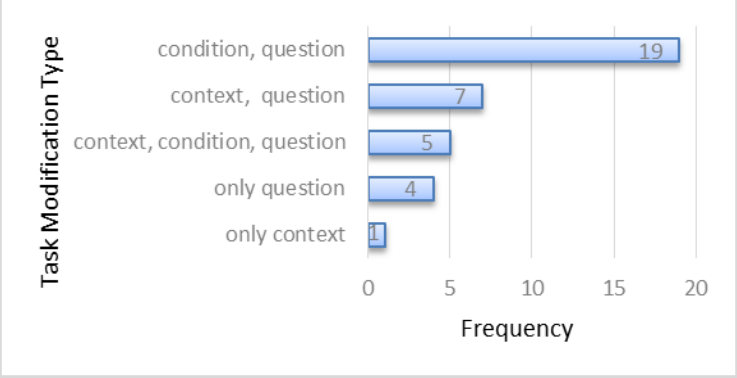


Figure 2 shows the frequencies for the task modification types of PMTs. As shown in Figure 2, about half of the PMTs (53%) used condition and question modifications mostly. Then, 7 (19%) PMTs used context and question modifications, 5 PMTs (14%) used context-condition-question modifications, 4 PMTs (11%) used only question modification, and 1 (3%) PMT used only context modification, respectively. The following sections provide examples for each type of modification as well as how PMTs apply their knowledge while making modifications.

Condition and Question Modifications

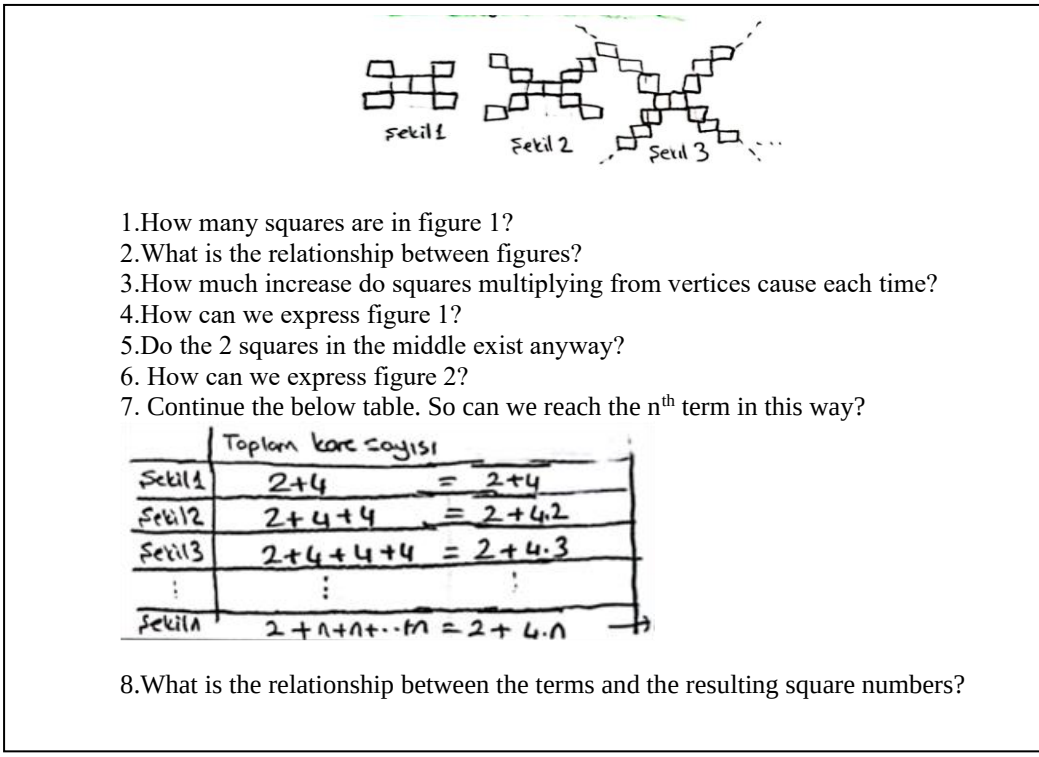
Out of the 36 tasks, 19 of them involved modifications to both the conditions and questions. The majority of PMTs modified the conditions to eliminate any misconceptions students may have regarding generalizations or to assist those who were having difficulty obtaining generalizations in the task. Most PMTs chose to include multiple representations, such as figures and/or tables, to help students understand the task.

Use of Figures in the Pattern

The majority of PMTs who chose to model the pattern with figures or material were able to do it accurately (9 out of 11). For instance, PMT1 stated that students struggled to identify the general rule in pattern generalization and express it algebraically. By illustrating this circumstance, she emphasized that students tend to find a rule by merely focusing on the difference between terms in numerical patterns that were constantly changing. She illustrated this argument by stating that students might first determine the difference as 4 increments and then determine the rule as n+4. Or, she asserted that they were more likely to continue the pattern and discover the next term (the fifth term) than to discover a general rule. To address these challenges and misunderstandings in determining the general rule, she recommended employing comprehensive questions (1-8) as opposed to merely asking for the general rule (see Figure 3). She intended to help students gain an awareness of generalization by adding new conditions to the third and fifth questions that would enable them to adopt a figural pattern and use figural reasoning. She also asked that they transmit the numerical relationships illustrating the fixed and expanding squares in the figures. Then, she posed the seventh question so that the students would feel compelled to develop a general rule, as they could not achieve the n^{th} term by writing down each step. In the final question, she drew attention to the functional relationship between the terms and the square numbers and asked the students to associate this relationship with the general rule. PMT1 modified the task conditions by assigning students tasks on the figure and table as well as step-by-step questions to determine the pattern generalization. She explained that this would facilitate a more meaningful learning experience and make it easier for students to develop mathematical concepts.

Figure 3

PMT1's Modified Task

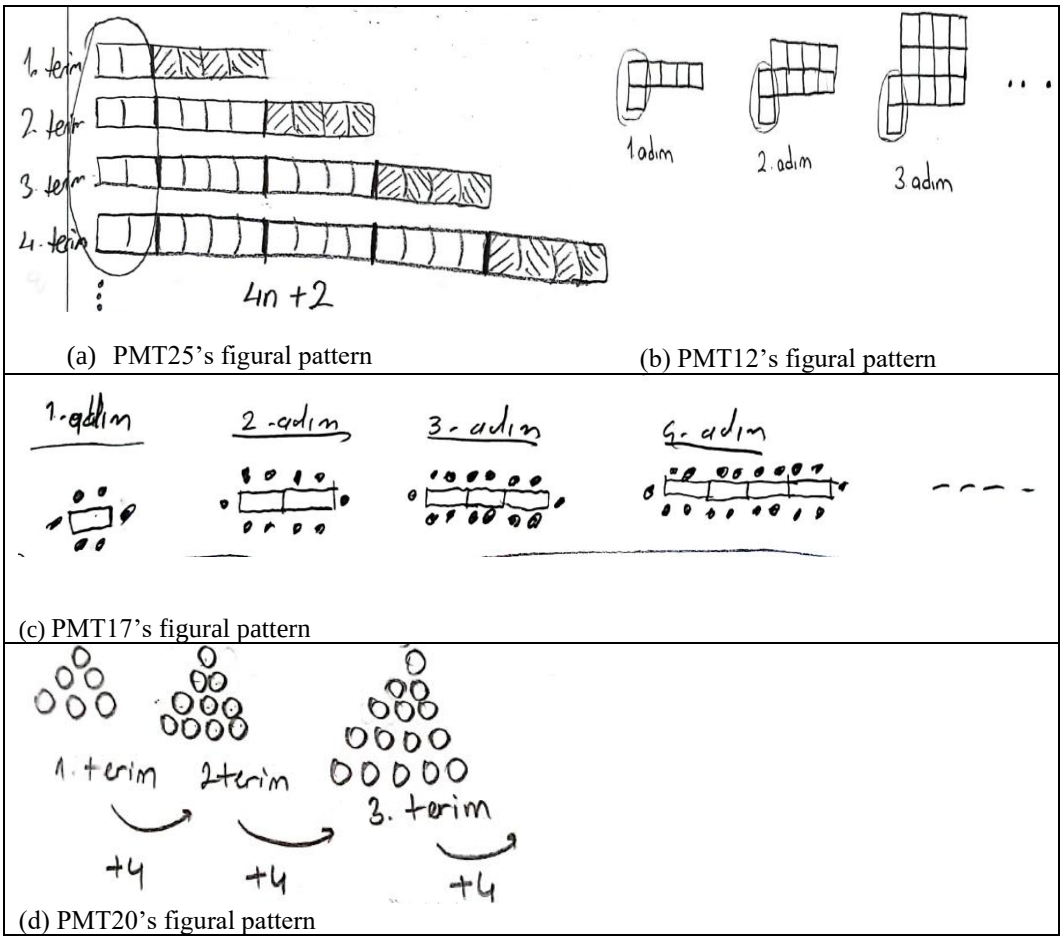


In addition, several PMTs utilized various shapes to support the figural pattern to facilitate the discovery of the general rule (see Figure 4). It was observed that the items utilizing the form positioned the squares in a different location so that students could observe the fixed 2 (PMT25 in Figure 4a and PMT12 in Figure 4b) or the points/chairs were put on both ends of the rectangle table and the number of points did not increase (PMT17 in Figure 4c). Students can deduct from these figures that the general rule has a constant of 2 and that other units increase by a factor of 4. In order to eliminate the difficulties in identifying the general rule and to prevent the misunderstanding of creating a general rule by focusing solely on the difference between terms, these PMTs modified their activities by adding figures to the number pattern by modifying the condition. This modification demonstrates that these PMTs' SCK is sufficient.

However, the PMTs with insufficient SCK were unable to utilize the figural pattern effectively. For instance, PMT20's figural pattern (see Figure 4d) did not correspond to the expected number pattern, yet she was unable to detect this. Even though the first two terms are 6 and 10, the third term contains 15 circles. Moreover, according to her method, the difference in the numbers of circles rises by one with each step, although it should remain constant at four. This demonstrates that PMT20 was unable to focus on figurative thinking or believing that just the first two terms fit, while the others did not. Consequently, this shows that her SCK is insufficient.

Figure 4

PMTs' Representations with Figures of the Pattern



(a) PMT25's figural pattern (b) PMT12's figural pattern

(c) PMT17's figural pattern

(d) PMT20's figural pattern

Use of Table Representation

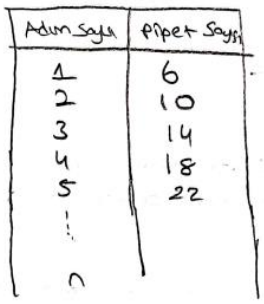
About half of the PMTs utilizing the table were unable to use it properly (5 out of 11). In Figure 5a, for instance, PMT24 wrote the position number in one column and the terms in the other column in the exact same order as the numerical pattern. This representation is insufficient to facilitate the functional reasoning of students. Or the use of some PMTs may result in more misconceptions. PMT3 demonstrated, for instance, in Figure 5b, that the second term is generated by adding 4 to the first term, and the third term is produced by adding 4 to the second term. This presentation may cause students to focus exclusively on the difference. Consequently, this notation may impede functional thinking between the number of steps and the term. In order to facilitate students' understanding, term order, term, and representations indicating the relationship should each be presented in a distinct column. The table created by PMT31 is a good illustration of this point (see Figure 5c).

In conclusion, when the PMTs had sufficient knowledge of the difficulties and misconceptions that students might have regarding pattern generalization (KCS), they attempted to change the condition of the task with the figure/model or table by employing their SCK to facilitate students' comprehension. However, PMTs that were unable to employ table representations effectively lacked appropriate SCK. In addition, PMTs inserted sub-questions to the task to allow for inductive reasoning considering the

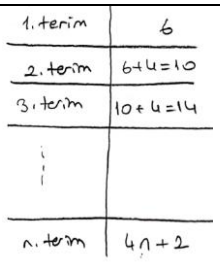
cognitive demand levels of the students. The use of these questions to stimulate student thinking shows the adequate KCTs of the PMTs.

Figure 5

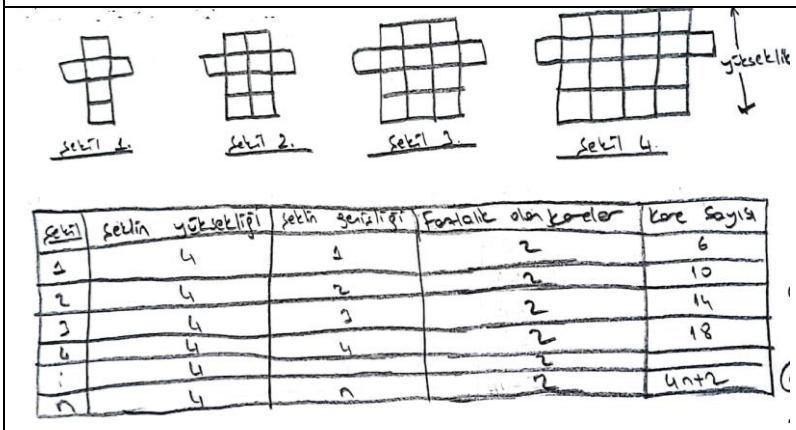
PMTs' Table Representations of the Pattern



(a) PMT24's table representation



(b) PMT3's table representation



c) PMT31's table representation

Context and Question Modifications

There are seven out of thirty-six tasks in which both the context and questions are modified. The PMTs who modified the context claimed that there were no contexts in the given task that might attract students' attention. Therefore, they proposed incorporating materials or contexts relevant to students' real-world experiences into the tasks. For instance, PMT10 believed that a problem based on reading as a context could help students create connections between mathematics and real life. The modified context was presented by PMT10 in Figure 6.

According to PMT10, the task shown in Figure 1 lacked an experiential opportunity for students to investigate real-life pattern generalization. He explained that this is due to the fact that this task requires students to create a rule using only numbers, implying abstract mathematics consisting of operations and rules. Consequently, he employed the context of reading books from the classroom or the students' daily lives. In Question 1 of Figure 6, he encouraged students to consider the functional relationship between the number of book pages and the number of days. The Questions (3-4-5) in Figure 5, PMT10 also asked students to apply the found algebraic relation. In Questions 3 and 5, he substituted 17 for n. In Question 4, which demands calculating the equation

102=4n+2 and provides inverse relationship thinking, he substituted 17 for n. In addition, there were items with contexts such as putting money in a piggy bank (PMT3), collecting stamps (PMT26), collecting butterflies (PMT36), and arranging the woods (PMT29 in Figure 7). These examples, taken from the context-modified tasks, were based on the experiences of the PMTs, who believed that the contexts in mathematical tasks should be associated with real-life situations and, consequently, the students' experiences or situations that could be encountered. These PMTs favored context-based instruction and utilized their KCT.

Figure 6

PMT10's Modified Task

Ali read 6 pages on the day he bought the book. Ali regularly reads 4 pages a day.

1) Express the relationship between the number of pages of the book and the number of days.
2) What is this relationship algebraically for the number of pages in the book that Ali reads from day to day?
3) According to the relationship, how many pages did Ali read in total on the 17th day?
4) On what day did Ali reach page 102?
5) Since Ali finished the book on the 57th day, how many pages is the book?

Context, Condition, and Question Modifications

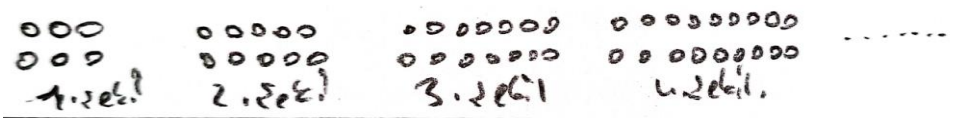
Five PMTs out of 36 opted to modify all three conditions simultaneously. When they modified questions, they tended to modify the conditions and context of the tasks along with the questions. For instance, PMT29 modified a mathematical context to a real-life environment by employing the wood-stacking context (see Figure 7). By inviting students to reflect on the background he employed, he also included questions that could stimulate class discussion. He guided the students step-by-step so that they would feel it necessary to discover the general rule. With the fourth and fifth questions, he was attempting to demonstrate that it was challenging to discover far terms by drawing or counting. He prompted them to consider if the seventh question's generalization might be applicable to all forms and explain why this was the case. Students were thus given the opportunity to consider the role of the general rule. In its assessment, PMT29 stated that this question gave students the opportunity to reflect on their own views by evaluating the solution's reasoning and providing an explanation. In addition, he highlighted the importance of asking for justification in the questions in order to allow students to use mathematical language and to allow for questioning. In addition to context and question modifications, PMT29 approximated the wood-stacking rule using a form and a pattern (see Figure 7). He explained that the purpose of this approach was to aid the student's figural reasoning and visualization.

In conclusion, we can state that the PMTs who need to make these three modifications utilize their KCT because of the order of the questions, and these questions contribute to the class discussion. They also use their SCK and KCS in the use of models or tables to aid students' understanding and must make these modifications.

Figure 7

PMT29's Modified Task

Mehmet cut 6 equal pieces of wood and arranged them as in the first figure. He continued to cut 4 equal woods every day after. He continued to arrange these woods, as shown in the figures.



1) Is there a relationship between the number of days and the number of woods?
2) What could the relationship be?
3) How many woods will there be in the 5th figure?
4) How many woods will there be in the 50th figure?
5) Is there any other way we can use instead of counting or drawing?
6) Can you express the relationship you found in (2) algebraically?
7) Does this relationship valid for all shapes? Please explain with justification.

Only Question or Only Context Modification

It may be noteworthy to evaluate the tasks and see that PMTs modified only one aspect. These tasks were not as effective for use in teaching the tasks with the combination of two or three modifications. For example, PMTs who made modifications solely to the questions posed them in general expressions. PMT8, for instance, emphasized the process that follows the discovery of the general rule, asking questions such as "Can you check the rule you found?" or "What does the general rule do?" Consequently, these questions would not assist students in the process of discovering the general rule. On the other hand, there was one PMT that modified the context only, PMT27. She posed a question with a contradiction: "Ali has 6 marbles. Each friend has four marbles. Ali will receive his marbles if he defeats another classmate in the race. How many students Ali has to beat to have 30 marbles in total?" Nonetheless, this problem is more about finding a result, or a value, than a general rule.

Discussion and Conclusions

In this study, the forms of task modifications performed by PMTs, as well as the types of teacher knowledge engaged throughout the modification process, are investigated. When PMTs worked on two or more forms of task modification, as compared to just one, they modified tasks more properly and comprehensively in a relevant manner, as stated in Lee et al.'s (2016) study. Accordingly, they frequently combined condition and question modification forms.

During the modification process, SCK and KCS were the two forms of knowledge that PMTs utilized most frequently. When PMTs had sufficient knowledge of the difficulties and misconceptions that students could have with pattern generalization (KCS), they attempted to modify the condition of the task using the figure/model or table by employing their SCK to facilitate students' comprehension. The PMTs indicated that students may have difficulties discovering and expressing the general rule algebraically. Prior research revealed that pupils had difficulty progressing beyond seeing and characterizing patterns to generalizing them and discovering function rules or algebraic representations (e.g., English & Warren, 1998; MacGregor & Stacey,

1995). In addition, the PMTs reported that students might employ a recursive strategy by focusing on the difference rather than the relationship between the position of terms and the term value. Warren (2000) discovered that students tended to prioritize recursive strategies over functional relations. Consequently, the KCS of PMTs is frequent enough. PMTs with this KCS were able to employ figures or models that give figural reasoning, demonstrating SCK to assist students with pattern generalization (Wilkie, 2014). Numerous research studies advocate employing figural reasoning to enhance students' comprehension of the link between evaluating the differences between figures (e.g., Barbosa & Vale, 2015; Becker & Rivera, 2005; Markworth, 2010; Walkowiak, 2014; Warren & Cooper, 2008). The use of figural reasoning, such as questioning the students about how the units in the figures get together and what the connection is based on, actually helps to understand the rule of the pattern conceptually (Thornton, 2001). Similarly, the use of tables indicates PMTs' SCK of pattern generalization (Wilkie, 2014). Students will benefit from the usage of diagrams, tables, spreadsheets, and figures (figural patterns) throughout the process of generalization (Lannin et al., 2006; Steele & Johanning, 2004). However, there are certain PTs who are unable to use the table to comprehend the functional relationship, which might indicate their lack of appropriate SCK knowledge. Warren and Cooper (2008) noted that establishing the connection between the position number and the corresponding word in the table rows can lead to an effective tabular representation of patterns.

PMTs who relied on KCS as their pedagogical content knowledge transformed the context, with a particular emphasis placed on those who considered the interests of students. Consequently, utilizing their KCT, they offered problems based on real-world or familiar contexts. In addition, they added questions to have students generalize patterns within a problem-solving process (Prestage & Perks, 2007). Thus, the PMTs modified the context and question by efficiently employing their KCT. Consequently, the PMTs that lacked appropriate KCT to instruct pattern generalization affected just the context or the question. However, as indicated by Lee et al. (2016), these single change types did not provide important opportunities to acquire pattern generalization.

In sum, we can state that teachers who need to make the three modifications also utilize SCK and KCS to assist students understand through the use of models or tables. Kaput (1999) also promoted a multi-representational approach, which entails giving students real-world experience in contexts they are familiar with and presenting issues using diagrams, tables of values, language, equations, and graphs to help students understand them. In particular, the PMTs who used figures or models built figural patterns and represented the constant within figures. Moss et al. (2008) suggested using these methods to support students' functional thinking and represent the general rule algebraically. In addition, the PMTs organized the questions in a way that encouraged inductive reasoning. At this time, we may assert that the KCT of the PMTs is adequate since the questions used to conduct the exercise allow the student to both generalize and contribute to the class discussion by promoting student thinking (Smith et al., 2008), PMTs also used their KCT in presenting the task within a context that required problem-solving as a teaching technique.

Teachers need to have a strong conceptual grasp of mathematics as well as an awareness of students' thinking to teach pattern generalization effectively (Girit Yildiz & Akyuz, 2020). According to Liljedahl et al. (2007), tasks can be changed more

efficiently if both mathematical and pedagogical elements are addressed. According to Magiera et al. (2013), prospective teachers have a limited ability to recognize the full potential of algebra-based tasks to elicit algebraic thinking in students because this ability is mainly based on their algebraic thinking. Similarly, content knowledge (Bartell et al., 2013) and particularly SCK allow teachers to analyze student thinking, aiding in the identification of student misunderstandings (Mosvold et al., 2014). However, content knowledge by itself is insufficient; prospective teachers must also acquire abilities such as task development and gain experience in this respect (Bartell et al., 2013; Callejo & Zapatera, 2021). When teachers lacked the necessary experience to design activities for teaching pattern generalization, they were unable to properly teach functional reasoning using tables or input-output values (Wilkie, 2014). According to Guberman and Leikin (2013), prior experience with multiple solution tasks allows prospective teachers to evaluate the interest and complexity of mathematics problems. In this sense, task modification activities can be a good way for future teachers to gain experience while learning about the role of mathematical tasks in teaching and learning mathematics (Lee et al., 2019).

Finally, this study has several limitations. The most significant limitation of this study was that PMTs did not perform their modified tasks with actual students. Thus, the work has implications for future task modification research. With the modification of tasks, the phases that include implementing the tasks and assessing students' understanding might be included. It is also important to examine what teachers notice about student thinking following implementation and what they would change as a consequence. Additionally, the data for this study are restricted to modified tasks and PMTs' written reflection reports. Future researchers can interview the participants to support the study's findings.

Author Bio:

Assist. Prof. Dr. Dilek Girit Yildiz is a faculty member of Trakya University School of Education Department of Mathematics and Science Education in Turkey. She got her PhD degree from Middle East Technical University Elementary Education Department. Her research interests are algebra teaching and learning, teacher knowledge, and prospective teachers' noticing skills.

References

Arbaugh, F., & Brown, C. A. (2005). Analyzing mathematical tasks: A catalyst for change? *Journal of Mathematics Teacher Education, 8*(6), 499-536. https://doi.org/10.1007/s10857-006-6585-3

Ayalon, M., Naftaliev, E., Levenson, E. S., & Levy, S. (2021). Prospective and in-service mathematics teachers' attention to a rich mathematics task while planning its implementation in the classroom. *International Journal of Science and Mathematics Education, 19(2021), 1695-1716.*

Ball, D. L. (2000). Bridging practices: Intertwining content and pedagogy in teaching and learning to teach. *Journal of Teacher Education, 51*(3), 241-247.

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education, 59*(5), 389- 407.

Barbosa, A., & Vale, I. (2015). Visualization in pattern generalization: Potential and challenges. *Journal of the European Teacher Education Network, 10,* 57-70.

Bartell, T. G., Webel, C., Bowen, B., & Dyson, N. (2013). Prospective teacher learning: Recognizing evidence of conceptual understanding. *Journal of Mathematics Teacher Education, 16*(1), 57–79.

Basyal, D., Jones, D. L., & Thapa, M. (2023). Cognitive demand of mathematics tasks in Nepali middle school mathematics textbooks. *International Journal of Science and Mathematics Education, 21,* 863–879. https://doi.org/10.1007/s10763-022-10269-3

Becker, J. R., & Rivera, F. (2005). Generalization schemes in algebra of beginning high school students. In H. Chick, & J. Vincent (Eds.), *Proceedings of the 29th conference of the international group for psychology of mathematics education (Vol. 4)* (pp. 121–128). Melbourne, Australia: University of Melbourne.

Boston, M. D. (2013). Connecting changes in secondary mathematics teachers' knowledge to their experiences in a professional development workshop. *Journal of Mathematics Teacher Education, 16*(1), 7–31. https://doi.org/10.1007/s10857-012-9211-6

Brown, S. I., & Walter, M. I. (1990). *The art of problem posing* (2nd Ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Callejo, M. L., & Zapatera, A. (2017). Prospective primary teachers' noticing of students' understanding of pattern generalization. *Journal of Mathematics Teacher Education, 20*(4), 309-333.

Chapman, O. (2013). Mathematical-task knowledge for teaching. *Journal of Mathematics Teacher Education, 16*(1), 1-6.

Cheng, L. P., Leong, Y. H., & Toh, W. Y. K. (2021). Singapore secondary school mathematics teachers' selection and modification of instructional materials for classroom use. In B. Kaur & Y. H. Leong (Eds.), *Mathematics instructional practices in Singapore secondary schools* (pp. 205-230). Singapore: Springer.

Crespo, S. (2003). Learning to pose mathematical problems: Exploring changes in pre-service teachers' practices. *Educational Studies in Mathematics, 52*(3), 243- 270.

Doerfler, W. (2008). En route from patterns to algebra: Comments and reflections. *ZDM Mathematics Education, 40*(1), 143–160.

Doyle, W. (1983). Academic work. *Review of Educational Research, 53*(2), 159–199.

English, L., & Warren, E. (1998). Introducing the variable through pattern exploration. *Mathematics Teacher, 91*(2), 166–170.

Girit Yildiz, D. G., & Akyuz, D. (2020). Mathematical knowledge of two middle school mathematics teachers in planning and teaching pattern generalization. *Ilkogretim Online - Elementary Education Online, 19*(4), 2098-2117.

Guberman, R., & Leikin, R. (2013). Interesting and difficult mathematical problems: changing teachers' views by employing multiple-solution tasks. *Journal of Mathematics Teacher Education, 16*(1), 33-56. https://doi.org/10.1007/s10857-012-9210-7

Haggarty, L., & Pepin, B. (2002). An investigation of mathematics textbooks and their

use in English, French and German classrooms: Who gets an opportunity to learn what? *British Educational Research Journal, 28*(4), 567-590.

Healy, L., & Hoyles, C. (1999). Visual and symbolic reasoning in mathematics: Making connections with computers. *Mathematical Thinking and Learning, 1(1),* 59–84.

Henningsen, M., & Stein, M. (1997). Mathematical tasks and student cognition: classroom-based factors that support and inhibit high-level mathematical thinking and reasoning. *Journal for Research in Mathematics Education, 28*(5), 524-549.

Hidayah, M., & Forgasz, H. (2020). A comparison of mathematical tasks types used in Indonesian and Australian textbooks based on geometry contents. *Journal on Mathematics Education, 11*(3), 385-404. https://doi.org/10.22342/JME.11.3.11754.385-404

Johnson, R., Severance, S., Penuel, W. R., & Leary, H. (2016). Teachers, tasks, and tensions lessons from a research practice partnership. *Journal of Mathematics Teacher Education, 19*(2), 169–185.

Kaput, J. J. (1999). Teaching and learning a new algebra. In E. Fennema & T. Romberg (Eds.), *Mathematics classrooms that promote understanding* (pp. 133–155). Mahwah, NJ: Erlbaum.

Kaur, B., & Lam, T. T. (2012). Reasoning, communication and connections in mathematics: An introduction. In B. Kaur & T. T. Lam (Eds.), *Reasoning, communication and connections in mathematics: Yearbook 2012 association of mathematics educators* (pp. 1–10). Singapore: World Scientific Publishing.

Kusaeri, K., Arrifadah, Y., & Asmiyah, S. (2022). Enhancing creative reasoning through mathematical task: The quest for an ideal design. *International Journal of Evaluation and Research in Education (IJERE), 11*(2), 482-490.

Lannin, J. K., Barker, D. D., & Townsend, B. E. (2006). Recursive and explicit rules: How can we build student algebraic understanding? *Journal of Mathematical Behavior, 25*(4), 299–317.

Lee, E.J., Lee, K.H. & Park, M. (2019). Developing pre-service teachers' abilities to modify mathematical tasks: Using noticing-oriented activities. *International Journal of Science and Mathematics Education, 17*(5), 965-985.

Lee, K. H., Lee, E. J., & Park, M. S. (2016). Task modification and knowledge utilization by Korean prospective mathematics teachers. *Pedagogical Research, 1*(2), 54.

Lee, M. Y., & Lee, J. E. (2021). An analysis of elementary prospective teachers' noticing of student pattern generalization strategies in mathematics. *Journal of Mathematics Teacher Education, 26,* 155-177. https://doi.org/10.1007/s10857-021-09520-5

Liljedahl, P., Chernoff, E., & Zazkis, R. (2007). Interweaving mathematics and pedagogy in task design: A tale of one task. *Journal of Mathematics Teacher Education, 10*(4), 239–249.

Llinares, S., & Krainer, K. (2006). Mathematics (student) teachers and teacher educator as learners. In A. Gutie'rrez & P. Boero (Eds.), *Handbook of research on the psychology of mathematics education: Past, present and future* (pp. 429–459). Rotterdam: Sense Publishers.

MacGregor, M., & Stacey, K. (1995). The effect of different approaches to algebra on students' perceptions of functional relationships. *Mathematics Education Research Journal, 7*(1), 69–85.

Magiera, M. T., van den Kieboom, L. A., & Moyer, J. C. (2013). An exploratory study of pre-service middle school teachers' knowledge of algebraic thinking. *Educational Studies in Mathematics, 84*(1), 93–113

Malara, N. A., & Navarra, G. (2009). The analysis of classroom-based processes as a key task in teacher training for the approach to early algebra. In B. Clarke, B. Grevholm, & R. Millman (Eds.), *Tasks in primary mathematics teacher education* (pp. 235–262). Berlin: Springer.

Markworth, K. A. (2010). *Growing and growing: Promoting functional thinking with geometric growing patterns* [Doctoral dissertation, University of North Carolina]. ProQuest Dissertations Publishing.

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation*. San Francisco, CA: Jossey-Bass.

Moss, J., Beatty, R., Barkin, S., & Shillolo, G. (2008). "What is your theory? what is your rule?" fourth graders build an understanding of functions through patterns and generalizing problems. In C. Greenes, & R. Rubenstein (Eds.), *Algebra and algebraic thinking in school mathematics: 70th NCTM yearbook* (pp. 155–168). Reston, VA: National Council of Teachers of Mathematics.

Mosvold, R., Jakobsen, A., & Jankvist, U. T. (2014). How mathematical knowledge for teaching may profit from the study of history of mathematics. *Science & Education, 23*(1), 47-60.

Papatistodemou, E., Potari, D., & Potta-Pantazi, D. (2014). Prospective teachers' attention on geometrical tasks. *Educational Studies in Mathematics, 86*(1), 1–18.

Pepin, B. E. U. (2015). *Enhancing mathematics / STEM education: a ''resourceful'' approach.* Technische Universiteit Eindhoven.

Prestage, S., & Perks, P. (2007). Developing teacher knowledge using a tool for creating tasks for the classroom. *Journal of Mathematics Teacher Education, 10*(4), 381-390.

Radford, L. (2008). Iconicity and contraction: a semiotic investigation of forms of algebraic generalizations of patterns in different contexts. *ZDM, 40*(1), 83–96.

Radford, L. (2011). Embodiment, perception and symbols in the development of early algebraic thinking. In B. Ubuz (Ed.), *Proceedings of the 35th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 4, pp. 17–24). Ankara, Turkey: PME.

Rivera, F. D. (2010). Visual templates in pattern generalization activity. *Educational Studies in Mathematics, 73*(3), 297-328.

Smith, E. (2008). Representational thinking as a framework for introducing functions in the elementary curriculum. In J. L. Kaput, D. W. Carraher, & M. L. Blanton (Eds.), *Algebra in the early grades* (pp. 133–160). New York: Taylor & Francis Group.

Smith, M. S., Bill, V., & Hughes, E. K. (2008). Thinking through a lesson: Successfully implementing high-level tasks. *Mathematics Teaching in the Middle School, 14*(3), 132-138.

Son, J. W., & Kim, O. K. (2015). Teachers' selection and enactment of mathematical problems from textbooks. *Mathematics Educational Research Journal, 27*(4), 491–518.

Steele, D. F., & Johanning, D. J. (2004). A schematic-theoretic view of problem solving and development of algebraic thinking. *Educational Studies in Mathematics, 57*(1), 65-90.

Stein, M. K., & Smith, M. S. (1998). Mathematical tasks as a framework for reflection: From research to practice. *Mathematics Teaching in the Middle School, 3*(4), 268-275.

Stein, M. K., Smith M. S., Henningsen, M. A. & Silver, E. A. (2000). *Implementing standards-based mathematics instruction: A casebook for professional development.* Teachers College Press.

Stephens, A. C. (2006). Equivalence and relational thinking: Pre-service elementary teachers' awareness of opportunities and misconceptions. *Journal of Mathematics Teacher Education, 9*(3), 249–278.

Sullivan, P. A., Clarke, D. M., & Clarke, B. A. (2009). Converting mathematics tasks to learning opportunities: An important aspect of knowledge for mathematics teaching. *Mathematics Education Research Journal, 21*(1), 85-105.

Sullivan, P. A., Clarke, D. M., Clarke, B. A., & O'Shea, H. F. (2010). Exploring the relationship between tasks, teacher actions, and student learning. *PNA (Revista de Investigación en Didáctica de la Matemática), 4*(4), 133- 142.

Sullivan, P., & Mousley, J. (2001). Thinking teaching: Seeing mathematics teachers as active decision makers. In F.-L. Lin & T. Cooney (Eds.), *Making sense of mathematics teacher education* (pp. 147–163). Dordrecht: Springer.

Strauss, A. & Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage.

Swan, M. (2008). Designing a multiple representation learning experience in secondary algebra. *Educational Designer, 1*(1), 1-17.

Thanheiser, E. (2015). Developing prospective teachers' conceptions with well-designed tasks: Explaining successes and analyzing conceptual difficulties. *Journal of Mathematics Teacher Education, 18*(2), 141-172. https://doi.org/10.1007/s10857-014- 9272-9

Thompson, D. R. (2012). Modifying textbook exercises to incorporate reasoning and communication into the primary mathematics classroom. In B. Kaur & T. Lam (Eds.), *Reasoning, communication and connections in mathematics* (pp. 57–74). Singapore: World Scientific Publishing Company.

Thomson, S. & Fleming, N. (2004). *Summing it up: Mathematics achievement in Australian schools in TIMMS 2002.* Melbourne: Australian Council for Educational Research.

Ubuz, B., Erbaş, A. K., Çetinkaya, B., & Özgeldi, M. (2010). Exploring the quality of the mathematical tasks in the new Turkish elementary school mathematics curriculum guidebook: The case of algebra. *ZDM-International Journal on Mathematics Education, 42*(5), 483-491.

Walkowiak, T. A. (2014). Elementary and middle school students' analyses of pictorial

growth patterns. *Journal of Mathematical Behavior, 33*(2014), 56-71.

Warren, E. (2000). Visualisation and the development of early understanding in algebra. Paper presented at *the 24th Conference of the International Group for the Psychology of Mathematics Education (PME),* Hiroshima, Japan.

Warren, E., & Cooper, T. (2008). Patterns that support early algebraic thinking in the elementary school. In C. Greenes, & R. Rubenstein (Eds.), *Algebra and algebraic thinking in school mathematics: 70th NCTM yearbook* (pp. 113–126). Reston, VA: National Council of Teachers of Mathematics.

Watson, A., & Mason, J. (2007). Taken-as-shared: a review of common assumptions about mathematical tasks in teacher education. *Journal of Mathematics Teacher Education, 10*(4), 205-215.

Wilkie, K. J. (2014). Upper primary school teachers' mathematical knowledge for teaching functional thinking in algebra. *Journal of Mathematics Teacher Education, 17*(5), 397-428.

Yıldırım, A. & Şimşek, H. (2013). *Sosyal bilimlerde nitel araştırma yöntemleri* (9. baskı). Ankara: Seçkin Yayıncılık.

Zaslavsky, O. (2008). Meeting the challenges of mathematics teacher education through design and use of tasks that facilitate teacher learning. In B. Jaworski & T. Wood (Eds.), *The mathematics teacher education as a developing professional* (pp. 93-114). Rotterdam: Sense Publishers.

Journal of Theoretical Educational Science, 16(3), 617-640, July 2023
Kuramsal Eğitimbilim Dergisi, 16(3), 617-640, Temmuz 2023
[Online]: http://dergipark.org.tr/akukeg
DOI number: http://doi.org/10.30831/akukeg.1238865

An Analysis of The Questions on Mathematical Literacy Designed by Mathematics Teachers with A Postgraduate Degree

Lisansüstü Eğitim Gören Matematik Öğretmenlerinin Tasarladıkları Matematik Okuryazarlığı Sorularının İncelenmesi

Ebru SAKA*

Received: 18 January 2023 **Research Article** **Accepted:** 14 June 2023

ABSTRACT: This study aimed to examine mathematical literacy questions designed by mathematics teachers with graduate-level in mathematical literacy concerning the categories of mathematical content, real-life context, and mathematical processes, which are dimensions of the PISA mathematical literacy framework. Another aim was to investigate the appropriateness of the classifications made by mathematics teachers for the mathematical literacy questions they designed. The study design was a qualitative case study. The participants of the study consist of six secondary school mathematics teachers who are attending a postgraduate mathematical literacy course at a state university in Turkey. The data of the research were obtained from three mathematical literacy questions designed by each of the participants and the classifications made for these questions. The study found that the majority of the questions designed by the participants fell into the category of "change and relationships," and questions related to real-life situations were mostly designed in the "personal" context, with the least number of questions designed in the "scientific" and "societal" contexts. Most questions included all three categories of mathematical processes when examined in terms of mathematical processes. In light of the results of this study, it can be suggested that the training to be provided in the future for writing questions related to mathematical literacy will greatly contribute to teachers.

Keywords: Mathematical literacy, mathematics teachers, question design.

ÖZ: Bu çalışmada lisansüstü matematik okuryazarlığı eğitimi almış matematik öğretmenlerinin tasarlamış oldukları matematik okuryazarlığı sorularını; PISA matematik okuryazarlığı çerçevesinin matematiksel içerik, gerçek yaşam kategorileri ve matematiksel süreçler boyutları açısından incelemek amaçlanmıştır. Bununla birlikte matematik öğretmenlerinin tasarladıkları matematik okuryazarlığı sorularına yönelik matematiksel içerik, gerçek yaşam kategorileri ve matematiksel süreçler açısından yaptıkları sınıflandırmaların uygunluğunun araştırılması çalışmanın bir diğer amacıdır. Çalışmada nitel araştırma desenlerinden durum çalışması yöntemi kullanılmıştır. Araştırmanın katılımcıları Türkiye'de bir devlet üniversitesinde lisansüstü matematik okuryazarlığı dersine devam eden altı ortaokul matematik öğretmeninden oluşmaktadır. Araştırmanın verileri katılımcıların tasarladığı üçer matematik okuryazarlığı sorusundan ve bu sorulara yönelik yaptıkları sınıflandırmalardan elde edilmiştir. Araştırmanın sonucunda katılımcıların tasarladıkları soruların büyük kısmının matematiksel içerik alanı bakımından değişim ve ilişkiler kategorisinde yer aldığı, gerçek yaşam kategorisi açısından soruların çoğunlukla kişisel bağlam kategorisinde tasarlandığı, en az sorunun ise bilimsel ve toplumsal bağlamda tasarlandığı tespit edilmiştir. Tasarlanan sorular içerdikleri matematiksel süreçler açısından incelendiğinde soruların büyük kısmının her üç matematiksel süreç kategorisini içerdiği belirlenmiştir. Çalışmadan elde edilen sonuçlar ışığında gelecekte matematik okuryazarlığı ile ilgili soru yazmaya yönelik verilecek eğitimlerin öğretmenlere büyük katkı sağlayacağı düşünülmektedir.

Anahtar kelimeler: Matematik okuryazarlığı, matematik öğretmenleri, soru tasarlama.

* Asst. Prof. Dr., Kafkas University, Kars, Türkiye, ebrudmirci@gmail.com, https://orcid.org/0000-0003-1975-3160

Citation Information
Saka, E. (2023). An analysis of the questions on mathematical literacy designed by mathematics teachers with a postgraduate degree. *Kuramsal Eğitimbilim Dergisi [Journal of Theoretical Educational Science], 16*(3), 617-640.

ISSN: 1308-1659

Considering the importance of mathematics in today's world, mathematics is inevitably one of the main areas covered in international studies. Standing out among many international assessment studies aimed at evaluating students' achievement in mathematics, the PISA (Programme for International Student Assessment) is one of the assessment tests in which Turkey also participates. PISA distinguishes itself from other international assessment studies because it focuses on the extent to which students who have completed compulsory education are able to apply the information in their everyday lives, as opposed to merely assessing their ability to recall curriculum-based information. When the literature is examined, many definitions of ML appear. In addition, PISA considers various dimensions when evaluating ML. First, the ML concept and the dimensions of the PISA ML framework are explained below. Then, in light of the literature, the role of teachers in ML and, finally, the research problems are included.

Mathematical Literacy and PISA

In PISA, students' mathematical skills to be measured are based on "mathematical literacy." Although the concept of Mathematical Literacy (ML) first appeared in the written sources of the National Council of Teachers of Mathematics (NCTM, 1989), the concept gained international recognition owing to PISA applications. ML is defined by the OECD (Organization for Economic Co-Operation and Development) as an individual's capacity to use mathematics in various ways for formulating, employing, and interpreting mathematics in real-life contexts (OECD, 2013). ML also helps individuals to understand the role of mathematics in the world and make the well-founded judgments and decisions that constructive, sensitive, and reflective citizens need (OECD, 2019).

By definition of ML, questions are presented in context to measure students' capacity to use mathematical skills in real life. Questions on ML in PISA tests include four different real-life contexts: personal, occupational, societal, and scientific contexts (OECD, 2019). The questions in the category of personal context focus on activities related to individuals, their families, and peers, while questions in the occupational context are business-oriented problems. The questions in the category of societal context are related to the communities in which people live, while the questions in the category of scientific context focus on mathematical practices related to science and technology. While real-life contexts are equally distributed in PISA-style questions on ML, the aim is to provide students with items that cover a wide range of individual interests and various situations they may encounter in their lives (OECD, 2019).

In addition, questions on ML include four content categories: change and relations, space and shape, quantity, uncertainty, and data, which consider the situation of students who have completed their compulsory education to measure basic competencies (OECD, 2019). By and large, the category of change and relationships includes the capacity to understand the variables in the data, understand and interpret them along with their relationships, and evaluate and transform them if necessary. This category includes perspective drawings, map drawings, drawing and transforming shapes, three-dimensional views, and the representation of figures. The quantity category includes determining the measurable properties of objects based on quantity, understanding, interpreting, and proving different numerical representations. In contrast,

the uncertainty and data category focus on understanding, interpreting, and evaluating various ambiguous and probabilistic situations.

ML focuses on the mathematical processes experienced by an individual who solves a problem and classifies the questions in the sub-dimensions of mathematical content and framework. Consequently, three mathematical processes are defined as an individual's capacity to formulate, employ, and interpret-evaluate mathematics within the PISA ML measurement and evaluation (OECD, 2013, 2016, 2019). Individuals are able to create a mathematical structure for a problem presented in the theoretical content after becoming aware of and recognizing the situations in which they can apply their mathematical knowledge and skills. The employing process refers to the situation where individuals employ mathematical concepts, facts, procedures, and reasoning to solve mathematically formulated problems and make mathematical decisions. On the other hand, the process of interpreting/evaluating refers to the interpretation and evaluation of the outcome or solutions by transferring them to a real-life context.

Teachers' Role in ML

The knowledge and skills required for ML are often included in existing mathematics curricula at schools (Genç & Erbaş, 2019). The learning areas of numbers and operations, algebra, geometry and measurement, and data processing and probability, which are instructed in five sections in the secondary school mathematics curriculum in Turkey, largely overlap with the subject areas determined by the PISA project in ML (Ministry of National Education [MoNE], 2009). Achieving success in any curriculum reform mainly depends on teachers giving due importance to the concepts of the reform or innovation movement (Handal & Herrington, 2003). Teachers are, therefore, expected to have an adequate understanding of ML and to know how to incorporate this understanding into their teaching practice whenever and wherever needed (Milton et al., 2007). However, raising mathematically literate students is necessary to meet the increasing expectations of the modern world, and this need is growing by the day (Edge, 2009). To meet this need, the biggest task falls to the teachers, who are responsible for preparing the necessary environment for the mathematical processes in the classroom. Nevertheless, the major challenge in bringing ML to the classroom is that teachers must first comprehend what ML is (Baştürk-Şahin, 2021). Besides that, it is also important for mathematics teachers to know the features that questions on ML should include and to bring these questions into the classroom environment when necessary to raise mathematically literate individuals (Kozaklı-Ülger et al., 2022; Mosher, 2015).

Studies conducted on teacher qualification, which is one of the components of ML teaching, emphasize the impact of teacher qualification on student performance and, accordingly, the fact that teacher qualifications exert a positive impact on students concerning the skills necessary for more effective learning (Akbaşlı et al., 2017; Demir & Altun, 2018; Mammadov & Çimen, 2019). In recent years, studies that provide mathematics literacy training to mathematics teachers and prospective teachers have become remarkable (Bansilal et al., 2015; Bozkurt, 2019: Canbazoğlu & Tarım, 2021; Kozaklı-Ülger et al., 2022; Özgen, 2019). In some of these studies, mathematics literacy questions designed by mathematics teachers and prospective mathematics teachers were examined in various dimensions. For instance, Kozaklı-Ülger et al. (2022) conducted a

ten-week mathematics literacy course to 28 secondary school mathematics teachers. They examined the participants' ability to pose ML problems in the context of problem posing. Similarly, Özgen (2019) examined the ML problem-posing skills of five mathematics teachers and 13 prospective mathematics teachers who had received ML education. In the study, ML problems developed by the participants were evaluated in terms of difficulty level, real-life context, mathematical content areas, and processes. Canbazoğlu and Tarım (2021) explored the ML problem-posing skills of 61 primary school teacher candidates and analyzed the problems regarding mathematical content areas, real-life contexts, and mathematical processes. In the first dimension of the present study, the problems designed by mathematics teachers will be examined in terms of ML dimensions, as Canbazoğlu and Tarım (2021) did. However, unlike Canbazoğlu and Tarım's (2021) study, the second dimension of this research will involve asking teachers to categorize the ML questions they designed according to ML dimensions and the appropriateness of these classifications will be assessed. Thus, the second dimension of the study aims to facilitate teachers' self-evaluation by having them categorize the questions they designed. Examining the appropriateness of the classifications was intended to reveal the extent to which the teachers internalized the ML process as a result of the provided course and reflected it on the ML questions.

Research Problem

This study will examine how mathematics teachers trained in ML reflect the ML framework in the questions they produce in line with the education they have received by focusing on their question-writing processes for ML. Within this framework, it is believed that teachers' way of carrying out the process of writing questions about ML is highly likely to contribute to their consideration of the dimensions that make up ML, to realize the relationship between mathematics and real life, and to help their students realize this relationship in the future. In addition, it is expected that this study will instruct teachers on how to incorporate ML-improving questions into future mathematics lessons.

From this perspective, the goal of this study is to look at the ML questions created by math teachers with graduate-level ML training regarding the PISA ML framework's three dimensions: mathematical content areas, real-world contexts, and mathematical processes. Another aim is to investigate the appropriateness of the classifications made by mathematics teachers in terms of mathematical content areas, real-life contexts, and mathematical processes for the ML questions they designed. From this standpoint, answers were sought to the following questions:

1. What is the distribution of the questions designed by mathematics teachers in terms of mathematical content areas, real-life contexts, and mathematical processes?
2. To what extent do the questions developed by mathematics teachers align with mathematical content areas, real-life contexts, and mathematical processes in assessing ML?

Method

Since the study aimed to examine the questions on ML designed by mathematics teachers in-depth, the case study method was used as one of the qualitative research design methods. Descriptive analysis and content analysis techniques were used to

examine the questions created by mathematics teachers with graduate-level ML training and the classifications assigned to these questions.

Participants

This study consisted of six secondary school mathematics teachers who had attended a postgraduate ML course at a public university in Turkey in the spring semester of the 2020/21 academic year. The research participants were determined by criterion sampling, one of the purposive sampling methods. In the criterion sampling method, the participants are formed from people, events, objects, or situations with the qualifications determined for the problem (Büyüköztürk et al., 2013). The criterion is created by the researcher, or a previously prepared criteria list can be used (Marshall & Rossman, 2014). In this study, it was a prerequisite for the participants to have completed postgraduate ML education. The participants were coded as T1, T2, …, and T6. Table 1 presents the relevant information on the participants' gender and professional experience.

Table 1

Demographic Information of the Participants

Participant	Gender	Years of work experience
T1	Female	2
T2	Female	10
T3	Female	2
T4	Female	5
T5	Female	3
T6	Female	3

As seen in Table 1, all of the teachers participating in this study were women whose professional experience ranged from two to ten years. All participating educators were employed in public schools. None of the participants had prior experience with ML training. Even if three participants were familiar with ML, their understanding was superficial. The other three participants did not know this concept before the training. In addition, the participants completed Mathematical Modeling and Activity-Based Learning in Mathematics Education courses during their graduate education. Participants worked on designing activities for the content of these two courses. In this sense, the participants had experience designing activities.

Data Collection

Data were collected from a total of 18 ML questions, which were designed by six mathematics teachers. Each teacher contributed three questions, and all of them had attended the graduate ML course during the spring semester of the 2020/21 academic year. The participants had received training for 12 weeks on the general framework of PISA on ML, ML levels, basic competencies of ML, questions on ML, and the basic features that the questions should encompass within the scope of the graduate ML course. The ML question design part of the course took six weeks. First, teachers were informed about Altun's (2020) ML question design references, which were explained in

detail in the data analysis section. Then, sample ML questions were examined regarding relevant references and dimensions of ML. Afterward, the teachers were given one week for each question design task and asked to design their questions. The designed questions were examined in the next week, feedback was given, and the teachers were asked to revise the questions.

Data Analysis

The initial focus of the data analysis was to determine whether or not the questions created by the teachers matched the nature of the questions on ML. Altun (2020) states that some reference information should be considered when writing an ML question. These are language issues, objecting to problems and questions in textbooks, considering basic concepts related to ML, and evaluating opportunities in daily life (Altun, 2020). In the study, the researchers gave the teachers one week to design each question, and they primarily looked at the designed questions using Altun's (2020) references for creating an ML question. In this direction, the designed questions were primarily examined regarding language. For this, the questions were examined in terms of whether they contain long and complex sentences, considering the level of the student and whether the active expression is used in the sentences. Then, it was checked whether the designed questions differed from those in traditional textbooks and whether they included verbs and actions that describe people's and society's needs. After that, whether the questions considered ML's basic concepts were examined in terms of mathematical processes. Finally, it was examined whether the questions reflected real-life situations. As a result of these examinations, the designed questions were discussed with the teachers, and feedback was provided to address any missing or incorrect aspects of the questions. In line with the feedback, the teachers revised their questions. For example, the first question designed by one of the participants (T3) for the first week was evaluated as weak in terms of real-life context and only required routine procedures. Consequently, T3 was requested to redesign a question based on the provided feedback regarding its apparent weaknesses. After the revisions, the questions prepared by the teachers were evaluated following the references for designing an ML question.

Then, the designed questions were analyzed using the descriptive analysis method regarding mathematical content areas, real-life contexts, and mathematical processes. Data collected in the descriptive analysis method are organized and interpreted according to predetermined themes (Miles & Huberman, 1994). In this situation, the OECD (2019) determined the components of ML and used them to analyze the teacher-designed ML questions descriptively. For this purpose, the ML questions designed by the teachers were divided into categories according to the dimensions of "mathematical content areas, real-life contexts, and mathematical processes." The obtained data are presented in tables and graphs. The analysis revealed that the questions designed by the teachers were categorized under a single context. It is almost impossible for a problem to completely contain all behaviors belonging to a process. The dominant phase in the solution is examined, and the problem is included in that process (Temel & Altun, 2020).

For this reason, in the analysis of mathematical processes, in cases where some of the questions designed by the teachers simultaneously included two different process

categories, the question was classified under the dominant mathematical process category. A sample analysis is presented below to analyze the questions on ML designed by the teachers in terms of such categories as mathematical content areas, real-life content, and mathematical processes and to determine whether or not the classifications made by the teachers are appropriate. A sample analysis is explained through the 1st question on ML designed by T2, presented in Figure 1.

Figure 1

The 1st Question on ML Designed by T2

COVID-19 can cause lung disease with various symptoms, such as dry cough, fever, and fatigue, by settling in the respiratory tract in the human body and further leading to diseases such as severe acute respiratory failure syndrome when not treated, thereby scaring the whole world since 2019. Those with severe co-morbidities and conditions may require inpatient treatment. Moreover, the death toll reported has been considerably high since the day the pandemic started. As a solution to such a problem, different countries started to produce and sell their vaccines in different ways. Turkey first decided to supply vaccines by BioNTech, produced in Germany, and CoronaVac, produced in China.

1) aving ordered 50 million CoronaVac vaccines together with 1 million BioNTech vaccines in the first batch and then 25 million more, Turkey planned to administer the vaccines in 2 doses at three-month intervals. With the aim of vaccinating 1.5 million people a day, in how many days would the vaccine run out for the first stage?

2) ince Turkey needed to vaccinate approximately 50 million people for the first dose, the vaccine cost created serious problems for the country's economy. Considering that the BioNTech vaccine was available for 19.5 dollars and the CoronaVac vaccine for 13.5 dollars each and that 2 doses of each vaccine were required, Turkey needed to allocate a substantial budget for obtaining the vaccines only. Generally speaking, to administer a newly produced vaccine, it must go through 3 phases. However, it also became inevitable to consider administering the domestic vaccine that Turkey would produce without implementing phase-3. The CoronaVac vaccine had also been received before phase-3 was completed. In this connection, phase-3 of the domestic vaccine was planned to be completed from April to September. When the domestic vaccine started to be administered, Turkey's vaccine cost was estimated to decline by at least 50%. If you were a decision maker for Turkey, how would you obtain the vaccine at the most affordable cost during the 6 months? Please present your calculations to support your answer.

3) eams of 4 people were formed in the health institutions assigned to vaccinate, and each employee was to vaccinate 60 people daily. For instance, 300,000 first-dose vaccines sent to the province of Iğdır had to be stored in cabinets at -70 degrees, but since there was no such storage area, the vaccination process had to be completed within 5 days. Based on this information, how many teams should be assigned to finish the process without contaminating the vaccines?

When the question presented in Figure 1 as designed by T2 is examined in terms of the mathematical content area category, the actions in the question are evaluated within the scope of the "quantity" category since they are mainly aimed at executing numerical operations, estimating with numbers, and making sense of numerical results. When the designed question is examined in terms of the real-life context category, it appears that the context of the problem is related to the health policies in the society in which the individual is included and to a certain social problem. For this reason, the real-life context category of the problem has been classified under the "social" category. Finally, given the mathematical durations in the 1st item of the question, the student solving the problem is expected to calculate how many days the vaccines will run out in the first place by dividing the total number of vaccines available by the number of

vaccines administered per day. The category of mathematical processes has been rated as the employment process because this question item involves performing the necessary actions and achieving the desired result. Moreover, in the 2nd item, the student solves the problem and is provided with different options for Turkey's vaccine supply and some information about their costs. This question requires the problem solver to develop different mathematical models and decide on the most cost-effective option for vaccine supply with the help of these models. The category of the particular mathematical process is interpreted as an evaluation since the question item requires discussing the significance of the mathematical results obtained in the real-life context and reaching a decision most appropriately. Like the case in the 1st item, the 3rd question item requires the problem solver to conduct incremental numerical operations to conclude. For this reason, the mathematical process category of this question item is also considered the employing process.

In the second stage of the data analysis, the appropriateness of the classifications was examined by comparing the classification made by the OECD (2019) according to the ML components used for the first research problem and the classification made by the teachers for the questions they had designed. When the classification made by the teachers for the mathematical content area category was consistent with the classification made by the OECD (2019), it was considered correct. When the content classification made by the teachers was given under the wrong category, it was considered incorrect. However, some of the questions designed by the teachers included two different content categories simultaneously, in which case, if the participants identified only one of the two different content categories correctly and failed to determine the other category, the classification was considered incomplete. Similar to the analysis for the appropriateness of content categories, the classification made by the teachers for the questions they designed was compared to that made by the OECD (2019) for real-life context to analyze the appropriateness of teachers' classifications for real-life situations. When the classification made by the teachers for the real-life context category was consistent with the classification made by the OECD (2019), it was deemed correct.

In contrast, the classification was deemed incorrect if it was assigned to the incorrect category. Finally, an examination of the teachers' categorizations of the mathematical process categories for the questions they developed. When the classifications made by the teachers were consistent with the definitions of mathematical processes made by the OECD (2019), they were considered correct. If participants did not fully identify the mathematical process in the designed question, their response was incomplete. If some of the mathematical processes included in the items of the designed question were classified correctly, and some were classified incorrectly or incompletely, they were considered partially appropriate. Table 2 illustrates the classifications T2 made for the question in Figure 1.

Table 2

The Classification for The First Question Designed by T2

Question Items	Mathematical Process	Content Category	Real-life context
1.	Employing	Change and Relations-(Misclassification)	Societal
2.	Interpreting and evaluating		
3.	Employing		

As shown in Table 2, although T2's first question falls under the quantity category, T2 has categorized this question under the change and relations category. For this reason, T2's classification for the content category is considered incorrect, while the classification T2 has made for the real-life context category is deemed correct. When the designed question is examined in terms of its mathematical processes, as stated in the first stage of the data analysis, the 1st and 3rd question items include the employing process. In contrast, the 2nd question item includes the interpretation-evaluation process. Table 2 demonstrates that T2 can correctly categorize the mathematical content categories of the question. As another example, although T5 determined the mathematical content area of the second question as quantity, the question also included the categories of change and relationships. Therefore, the classification made by T5 under the mathematical content category was considered incomplete. Besides, if the participants stated that the question included all three categories of mathematical processes, although the question did not include some of the categories, it was considered partially appropriate. For instance, although T1 stated that the third question included all three categories of mathematical processes, it turned out that it included the processes of formulating and employing, not the interpretation-evaluation process. For this reason, the classification made by T1 for the 3rd question was considered partially appropriate.

Validity and Reliability

Another expert in the field examined the data on hand independently and classified the questions in terms of content, context, and mathematical operations before determining whether the designed questions were appropriate for the teachers' classification. Then, the analyses made by both researchers were compared. The agreement rate between the researchers' analyses was determined as 89% by using the Miles & Huberman formula. The researchers discussed the points of disagreement in the analyses and reached a consensus for the points of disagreement. For example, in the analysis carried out by two independent researchers, the formulation process of the second question designed by T2 was included in the classification of the mathematical process category by the researcher at the beginning. The other field researcher, on the other hand, did not classify the question during its formulation in her analysis. Two field researchers reached a consensus after discussing the designed question that it includes the employing, interpreting, and evaluating processes but not the formulation process. The results were reported in accordance with scientific and ethical standards.

Ethical Procedures

Ethical approval and written permission were obtained from the Kafkas University Social and Human Sciences Ethics Committee, with the decision dated July 12, 2021, and numbered 21/11. The research was carried out following ethical rules at every stage. The participation of the candidates in the research took place voluntarily.

Results

This study investigated the questions on ML that mathematics teachers designed with a graduate-level education in ML, as well as the appropriateness of the classifications made by the teachers for the questions they designed. The results were presented according to the sub-problems of the study.

Distribution of Questions on ML Designed by Mathematics Teachers in terms of Mathematical Content, Real-Life Context, and Mathematical Processes

Table 3 presents the distribution of eighteen questions on ML designed by six mathematics teachers according to mathematical content categories.

Table 3

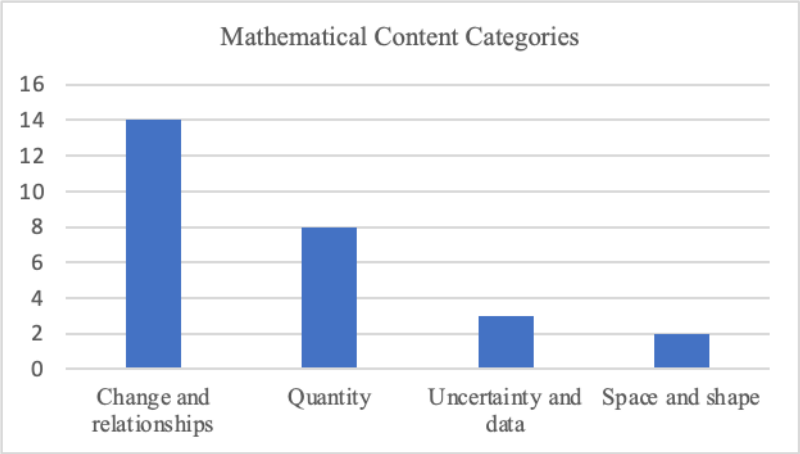
Mathematical Content Categories of Questions Designed by Mathematics Teachers

Participant	Question 1	Question 2	Question 3
T1	Uncertainty and Data Change and Relationships	Change and Relationships Quantity	Change and Relationships
T2	Quantity	Change and Relationships Space and Shape	Quantity
T3	Change and Relationships	Change and Relationships	Change and Relationships Quantity
T4	Change and Relationships Quantity	Change and Relationships Quantity	Change and Relationships Quantity
T5	Change and Relationships	Change and Relationships Quantity	Space and Shape Change and Relationships
T6	Change and Relationships	Uncertainty and Data	Uncertainty and Data

As seen from Table 3, most of the questions designed by mathematics teachers were in the category of change and relationships. However, nine of the problems designed by teachers included two different content categories at the same time. Figure 2 illustrates the distribution of the designed questions according to the mathematical content categories.

Figure 2

Distribution of Questions Designed by Mathematics Teachers According to Mathematical Content Categories



As shown in Figure 2, 14 (78%) of 18 questions on ML designed by mathematics teachers fell in the category of change and relationships. Eight of the designed questions fell in the category of quantity, three in the category of uncertainty and data, and two in the category of space and shape. It appeared that the participants designed most of the questions under the sub-learning areas of percentages and equality-equation under the category of change and relationships. When it came to the category of quantity, it seemed that they mostly included questions requiring arithmetic solutions and questions that included estimation. Furthermore, the analysis of the questions indicated that the sub-learning fields of area measurement and liquid measurement were included in two questions designed for the category of space and shape. The three questions designed for uncertainty and data were created for data analysis, creating tables, and the probability of simple events.

Table 4 shows the distribution of ML questions that the mathematics teachers created following real-world categories.

Table 4

Classification of Questions in Conformity with Real-Life Situations

Participant	Question 1	Question 2	Question 3
T1	Societal	Personal	Occupational
T2	Societal	Personal	Personal
T3	Occupational	Personal	Personal
T4	Occupational	Occupational	Personal
T5	Scientific	Occupational	Personal
T6	Scientific	Personal	Personal

As shown in Table 4, mathematics teachers appeared to have included different contexts in their questions on ML. For example, T1 and T5 included different contexts in all three questions they designed.

Figure 3

Distribution of Questions Designed by Mathematics Teachers According to the Category of Real-Life Situations

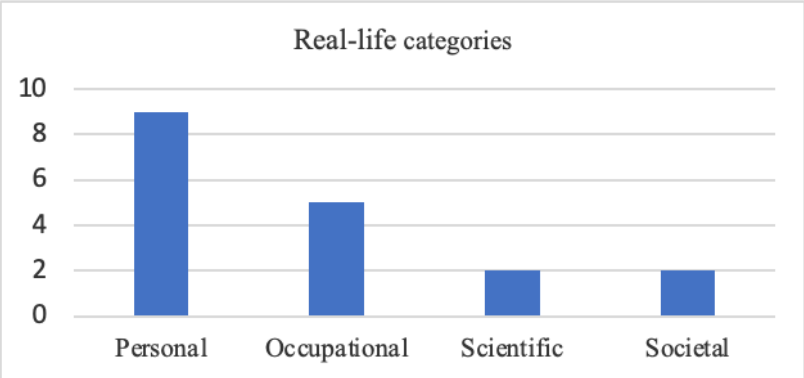


Figure 3 illustrates the distribution of the designed questions according to real-life categories. As shown in Figure 3, half of the designed questions are in the personal context category, five are in the occupational context, and two are in the scientific and social categories. For example, the activity named "Coronavirus," the 1st question on ML designed by T1, was evaluated in the societal category in terms of real-life context. In the activity, T1 was asked to predict when the virus spread would decrease according to the conditions given in the activity by using the map that showed the coronavirus risk status of cities published by the Ministry of Health every 15 days in Turkey. Since the activity included a situation related to society, it was evaluated under the category of societal context. In another activity named "Parallax Method," which was the 1st question on ML designed by T5 and evaluated in the scientific category (See Appendix 1), a mathematical method was mentioned to be used to determine the distances of objects, requiring a formula to be developed for finding the distance between any object measured by this method and the person making the measurement. In this respect, the designed activity was evaluated in the scientific category since it included a situation related to the nature of mathematics itself.

Table 5 shows the distribution of questions on ML designed according to the mathematical process categories.

Table 5

Mathematical Processes Included in The Questions Designed by Mathematics Teachers

Participant	Question 1	Question 2	Question 3
T1	Formulating Employing	Formulating Employing	Formulating Employing
T2	Employing Interpreting and evaluating	Formulating Employing Interpreting and evaluating	Formulating Employing Interpreting and evaluating
T3	Formulating Employing	Formulating Employing	Formulating Employing Interpreting and

		Interpreting and evaluating	evaluating
T4	Formulating Employing Interpreting and evaluating	Formulating Employing Interpreting and evaluating	Formulating Employing
T5	Formulating Employing Interpreting and evaluating	Formulating Employing Interpreting and evaluating	Formulating Employing Interpreting and evaluating
T6	Formulating Employing Interpreting and evaluating	Formulating Employing Interpreting and evaluating	Formulating Employing Interpreting and evaluating

As seen in Table 5, most of the questions on ML designed by mathematics teachers, except for T1, include all three mathematical process categories. In contrast, those designed by T1 were limited to the processes of formulating and employing and did not include the process of interpretation and evaluation. The first question designed by T2 did not include the formulation process. In addition, one of the three questions designed by T3 and T4 did not include the interpretation and evaluation process.

Figure 4

Distribution of Questions Designed by Mathematics Teachers According to Mathematical Processes

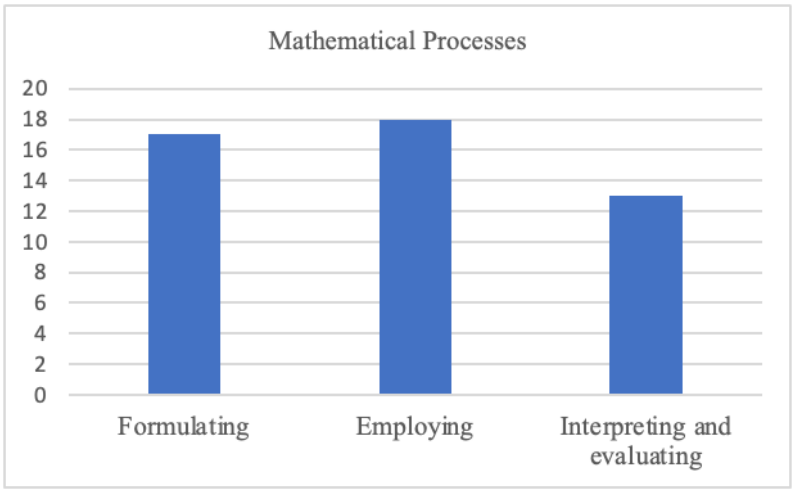


Figure 4 illustrates the distribution of the designed questions according to mathematical processes. As shown in Figure 4, all the designed questions include the employing process. Only one of the designed questions did not include the formulation process. Five (%28) of 18 questions designed by mathematics teachers did not include the interpretation and evaluation process.

The Appropriateness of the Classifications Made by The Mathematics Teachers for the Questions They Designed on ML

This section focused on examining the extent of the appropriateness of the classifications made by six mathematics teachers in terms of mathematical content, real-life context, and mathematical processes for each of the three questions on ML. Table 6 presents the findings obtained from the analysis of the category of mathematical content determined by the mathematics teachers for the three questions designed.

Table 6

The Appropriateness of The Classifications Made by The Mathematics Teachers According to The Mathematical Content Categories of The Questions They Designed

Participant	Question 1	Question 2	Question 3
T1	Incomplete	Incomplete	Correct
T2	Incorrect	Correct	Correct
T3	Incorrect	Incorrect	Incomplete
T4	Correct	Correct	Correct
T5	Correct	Incomplete	Correct
T6	Correct	Correct	Incorrect

As seen in Table 6, only T4 could correctly determine the mathematical content category of all three questions she designed. T2 and T6 were able to classify two of the three questions they designed correctly, but they classified one question under the wrong category. Although T2 intended for the question to fall under the category of quantity, she placed it under the category of change and relationships. Similarly, T6 classified her third question on ML under the category of change and relationships; however, when the content area of the question was examined, it turned out that it was indeed related to the category of uncertainty and data. The analysis of T5's classifications for the questions revealed that she had classified the first and third of her questions according to the appropriate mathematical content area yet failed to fully determine the second question in conformity with the relevant content area since she specified the mathematical content area of that question as to quantity only, though the question should have been included in the category of change and relationships as well. Another participant, T1, on the other hand, classified only one of the three questions she designed under the appropriate content category and underdetermined the content area of the other two questions. Although T1 classified the first question she designed under the category of change and relationships, as a matter of fact, the question also belonged to the category of uncertainty and data. T3, on the other hand, determined the content category of two of the three questions she designed incorrectly, and the other one was incomplete. It seemed clear that the first two questions had been designed in conformity with the category of change and relationships; however, T3 classified them under the category of quantity. Moreover, although T3 classified the third question she designed under the category of quantity when the question was examined, it turned out that it should also have been included in the category of change and relationships.

Table 7 presents the results obtained from the analysis of the classifications made by the mathematics teachers participating in this study regarding the "real-life context" category for the three questions designed.

Table 7

The Appropriateness of the Classifications Made by The Mathematics Teachers for The Questions They Designed According to The Category of Real-Life Situations

Participant	Question 1	Question 2	Question 3
T1	Correct	Incorrect	Incorrect
T2	Correct	Correct	Correct.
T3	Incorrect	Correct	Correct
T4	Correct	Correct	Correct
T5	Correct	Correct	Correct
T6	Correct	Correct	Correct

As seen from Table 7, four of the six mathematics teachers determined the questions appropriately in conformity with real-life situations. When the first question designed by T3 was examined, it seemed that the content of the question was about the cheese production process and was designed to require ratio and percentage calculations for the nutritional elements in the cheese content. T3 classified the question under the societal category in terms of real-life context; however, the question should have been evaluated under the category of occupational context since it included a context concerning a profession. Therefore, T3's classification of the first question was considered incorrect. While T1 could determine the real-life category of the first of her three questions, she misclassified the second and third questions. The content of the second question included situations such as choosing the most appropriate route for a journey by using navigation, how long the journey would take according to the variables given in the question, and what the average speed should be. Although T1 classified the question under the societal category in terms of real-life context, it seemed appropriate to classify it under the personal category since it was related to an event that the individual may have experienced and was not a society-related problem.

As a result, T1's classification was determined to be incorrect. The third question, on the other hand, was designed to calculate the amount of yarn obtained from spider webs on a farm and the number of bulletproof vests produced from that yarn. T1 classified that question under the category of societal context from among real-life situations. However, when the content of the question was examined, it seemed clear that it fell under the occupational context category since it was designed to concern a production process belonging to a particular profession. It was thus determined that the classification made by T1 was incorrect.

Table 8 presents the findings obtained from the analysis of the classifications made by the mathematics teachers in terms of the mathematical process category for the three questions they had designed.

Table 8

The Appropriateness of The Classifications Made by The Mathematics Teachers According to The Mathematical Process Categories for The Questions Designed

Participant	Question 1	Question 2	Question 3
T1	Incomplete	Partially appropriate	Partially appropriate
T2	Appropriate	Appropriate	Appropriate
T3	Appropriate	Appropriate	Appropriate
T4	Appropriate	Appropriate	Appropriate
T5	Appropriate	Appropriate	Appropriate
T6	Appropriate	Appropriate	Appropriate

As seen from Table 8, five of the six mathematics teachers could determine the mathematical process categories appropriately included in all the questions they designed. However, T1 specified the mathematical process category of the first question she designed incompletely. In contrast, her classification according to the mathematical process category of the other two questions was partially appropriate. T1 only classified her first question's mathematical content area as the formulating process. However, when the question was examined, it turned out that, besides the formulation process, it required processes such as finding information based on a given map, developing a strategy to come up with mathematical results, or employing mathematical rules. Thus, it appeared that the mathematical process of the problem designed by T1 also included the process of employing.

For this reason, the classification made by T1 for her first question was considered incomplete. As regards her classification for the second question, T1 stated that the question included all three categories of mathematical processes. However, when the content of the question was examined, it was found that although it included the processes of formulating and employing, it did not include the interpretation-evaluation process. From this standpoint, the mathematical process classification that T1 made for the second question was partially appropriate. Similarly, although T1 stated that Question 3 included all three categories of mathematical processes, the question turned out to be included in the interpretation-evaluation process only. The classification made by T1 for Question 3 was also considered partially appropriate.

Discussion and Conclusion

As a result of this study, most of the questions designed by the participating mathematics teachers were found to be in the category of change and relationships, followed by the category of quantity in terms of the mathematical content area. The least number of problems were found in space and shape, uncertainty, and data categories. This study's results were in parallel with those obtained from the study in which Kohar et al. (2019) examined the PISA-like questions designed by 14 pre-service mathematics teachers. The analysis of the distribution of ML questions according to real-world categories revealed that the majority of questions were designed for the personal context, followed by the occupational context, and the fewest questions were designed for the scientific and societal contexts. These results align with those reported by Canbazoğlu and Tarım (2021), who examined the problem-posing skills of

prospective classroom teachers regarding ML. Additionally, given the results of the studies focusing on designing questions on ML, it frequently appears that most questions are likely to be designed in a personal context (Baran-Saraç, 2021; Kohar et al., 2019; Özgen, 2019; Şahin & Başgül, 2018). It can be assumed that this situation derives from the fact that teachers commonly associate mathematics with personal contexts such as shopping, travel, nutrition, and housing. The result obtained from the study conducted by Suharta and Suarjana (2018) with 12 pre-service teachers indicates that pre-service teachers can associate mathematics with the problems presented in a personal context more easily, supporting this result of the present study. In a study by Kohar et al. (2019), while pre-service teachers mostly designed questions in a personal context, they designed only a few questions in a scientific context. The researchers stated that the reason for very few questions designed in a scientific context was the nature of scientific knowledge or the difficulties of searching for accurate data in sources and finding reliable sources. However, in this study, although the teachers encountered questions related to all types of contexts in graduate courses, they could freely determine the contexts of the questions they would design in the practice part of the present study. However, research has shown that using various contexts in questions on ML increases the likelihood of students associating the problems with the situations they are dealing with in the 21st century (OECD, 2013). In light of this, teachers should be inspired and encouraged to create questions with varying contexts by analyzing the types of questions on ML, which contain a variety of contexts.

Examining the questions on ML that the mathematics teachers created in terms of the mathematical processes reveals that, with the exception of T1, the majority of the questions included all three categories of mathematical processes. However, the questions on ML designed by T1 were limited to the processes of formulating and employing and did not include the processes of interpretation and evaluation. The first question designed by T2 did not include the formulation process. In addition, two of the three questions, T3 and T4, failed to include the interpretation and evaluation process. Although the teachers were free to determine the content and context types of the questions they would design, the participants were asked to include all three mathematical processes in the questions.

Consequently, teachers seemed to try to consider all mathematical processes in the questions they would design. In a related study by Baran-Saraç (2021), it was found that while the pre-service teachers initially designed questions at the level of formulating and employing, it turned out that they expanded the diversity of the mathematical processes of the problems on ML and that the problems they created covered more than one process after the teaching experience. Similarly, the effectiveness of postgraduate education can be inferred from the fact that teachers tended to include multiple processes in their questions. However, it is also noteworthy that three questions designed by T1, and one question each designed by T3 and T4, did not include the interpretation and evaluation process. Similarly, Kohar et al. (2019) reported that most PISA-like questions designed by pre-service teachers involve the hiring process. Baştürk-Şahin and Altun (2019) and Gürbüz (2014) concluded that pre-service teachers generally have difficulties producing questions that require interpretation-evaluation skills. It is believed that the reason for this is that teachers are most familiar with the multiple-choice questions in the textbooks and central exams in

Turkey, which include the hiring process. Öztürk (2020) investigated the PISA ML proficiency levels of the mathematics questions in the central exam of the High School Transition System (LGS) and concluded that the questions did not cover all the levels but were concentrated at the 2nd level in general. Similarly, Ekinci and Bal (2019) classified the mathematics questions in the LGS exam held in 2018 according to the Revised Bloom Taxonomy by including only the questions in the "application" and "analysis" steps. They stated that no questions were found in "recalling, understanding, evaluating, and synthesizing." Another study that examined the questions in the 8th-grade mathematics textbook based on PISA ML proficiency levels reported that the questions in the first four levels were generally included in the book. In contrast, the questions in the 5th and 6th levels were never encountered (Aydoğdu-İskenderoğlu & Baki, 2011). The results of the studies support those found in the present study. However, creating a ML question is not an easy activity. Studies conducted with teachers and teacher candidates on ML revealed that participants had difficulties creating ML questions (Demir & Altun, 2018; Özgen, 2019; Saenz, 2009). The fact that teachers create fewer questions about the interpretation and evaluation process can be seen as a reflection of the beliefs about mathematics education, as the participants perceive mathematics more dominantly in the operational dimension, as Özgen (2019) states. Based on these results, it is suggested that in future training on ML, more emphasis should be placed on the interpretation and evaluation process, both in problem-solving and problem design.

The second part of the study aimed to examine the appropriateness of the classifications in terms of mathematical content categories, real-life categories, and mathematical processes for the three questions. According to the results, while the content categories of 10 of the 18 questions designed by six teachers were determined correctly, four were deemed incomplete, and the other four were incorrect. The incompleteness of the content category of the questions seemed to have stemmed from the fact that they contained two different contents simultaneously. While PISA emphasizes that classification by content category is important for item development and selection, it is also essential to note that certain content issues may develop in more than one content category (OECD, 2013). The reason for this lies in the nature of the PISA task, which is based on the contextual environment in which more than one branch of mathematics is used (Kohar et al., 2019). The analysis of the classifications made by the mathematics teachers for the questions they designed in terms of the real-life category revealed that only three of the 18 questions were determined incorrectly. In this regard, the results indicated that teachers were more adept at identifying the real-world categories of the questions than the content categories. Finally, five of the six mathematics teachers participating in the present study could determine the mathematical process categories appropriately in all the questions they designed. At the same time, T1 made an incomplete specification for the mathematical process category of the first question. Moreover, her classification according to the mathematical process category of the other two questions was partially appropriate. Furthermore, Baştürk-Şahin and Altun (2019) examined the questions prepared by 66 teacher candidates about ML and concluded that 36% of the pre-service teachers could identify all mathematical processes and correctly produce appropriate questions. Compared with the results of this study, it is believed that the postgraduate course provided to the teachers proved

effective in determining mathematical processing skills. Gürbüz (2014), on the other hand, stated that pre-service teachers were more successful in classifying PISA questions than writing. The researcher explained this situation as the participants' lack of experience in writing questions. In this study, however, teachers were largely successful in both ML question design and classification. In addition, it is thought that the effects of courses such as Mathematical Modeling and Activity-Based Learning in Mathematics Education that they take in graduate education were also important in the overall success of the ML questions designed by the teachers. Studies on ML question design generally seem to have positive effects on participants. Kozaklı-Ülger et al. (2022) stated that teachers could pose ML problems, but this potential can be developed by spending more time on such problems. For this reason, it is recommended to carry out longitudinal studies on ML to develop the potential of teachers.

Implications

The mathematics literacy course is believed to yield positive outcomes regarding the products the teachers created. In light of the results of this study, it can be suggested that the training to be provided to write questions on ML in the future is highly likely to benefit the teachers. For that reason, increasing the number of relevant training sessions on writing ML-related questions can be recommended. For this, in-service training can be organized for teachers, and workshops and projects can be carried out by field experts on ML. In ML training, it is suggested that teachers should be inspired and encouraged to create questions with varying contexts by analyzing the types of questions on ML, which contain a variety of contexts. Also, it is suggested that in future training on ML, more emphasis should be placed on the interpretation and evaluation process, both in problem-solving and problem design. In this study, after 12 weeks of ML training, the ML design process took 6 weeks. In future studies, it is recommended to devote more time to the ML question design process and to emphasize the interpretation and evaluation process. This study has limitations in some respects, such as the lack of interviews and reflective thinking reports. Considering these limitations, more comprehensive studies can be done in the future.

Author Bio:

Ebru SAKA is Asst. Prof. Dr. at Kafkas University, Department of Mathematics and Science Education. She has a PhD degree in mathematical modelling in mathematics education. She also studies problem solving, problem posing, mathematical literacy and teacher education.

References

Akbaşlı, S., Şahin, M., & Yaykiran, P. S. Z. (2017). Teacher qualification influence on teaching cross-curricular skills: A study based on PISA 2015 assessment. *Journal of Education and Practice, 8*(18), 21-29.

Altun, M. (2020). *Matematik okuryazarlığı el kitabı*. Aktüel Alfa Akademi Yayıncılık.

Aydoğdu İskenderoglu, T., & Baki, A. (2011). Quantitative analysis of pre-service elementary mathematics teachers' opinions about doing mathematical proof. *Educational Sciences: Theory and Practice, 11*(4), 2285-2290.

Bansilal, S., James, A., & Webb, L. (2015). Teacher training for mathematical literacy: A case study taking the past into the future. *South African Journal of Education, 35*(1), 1-10. https://hdl.handle.net/10520/EJC167028

Baran-Saraç, A. B. (2021). *A study on development of prospective middle school 'teachers' competence of posing mathematical literacy problems* [Unpublished Master's thesis]. Middle East Technical University.

Baştürk-Şahin, B. N. (2021). *Analysing mathematics teachers' professional development on mathematical literacy within the framework of documentational approach* [Unpublished Master's thesis]. Bursa Uludağ University.

Baştürk-Şahin, B. N., & Altun, M. (2019). Investigating mathematical literacy problems that pre-service mathematics teachers posed by means of mathematical processes. *Western Anatolia Journal of Educational Sciences, 10*(2), 146-161.

Bozkurt, I. (2019). *The investigation of the development of students' mathematical literacy who are educated by mathematic teachers trained about mathematical literacy* [Unpublished doctoral dissertation]. Bursa Uludag University.

Büyüköztürk, Ş., Akgün, Ö. E., Karadeniz, Ş., Demirel, F., & Kılıç, E. (2013). *Bilimsel araştırma yöntemleri.* Pegem Akademi.

Canbazoglu, H. B., & Tarım, K. (2021). Mathematical literacy problem posing skills and mathematical activity development processes of primary school teacher candidates. *Journal of National Education, 50*(231), 147-172. https://doi.org/10.37669/milliegitim.743434

Demir, F., & Altun, M. (2018). Development of mathematical literacy question writing process and skills *Education and Science, 43*(194), 19-41. http://dx.doi.org/10.15390/EB.2018.7111

Edge, D. L. (2009). Math literacy: *The relationship of algebra, gender, ethnicity, socioeconomic status and avid enrollment with high scholl math course completion and college readiness* [Unpublished doctoral dissertation]. University of North Texas.

Ekinci, O., & Bal, A. P. (2019). Evaluation of high school entrance exam (LGS) 2018 in terms of mathematics learning field and revised bloom taxonomy. *Journal of Social Sciences of Mus Alparslan University, 7*(3), 9-18. https://doi.org/10.18506/anemon.462717

Genç, M., & Erbaş, A. K. (2019). Secondary mathematics 'teachers' conceptions of mathematical literacy. *International Journal of Education in Mathematics, Science and Technology (IJEMST), 7*(3), 222-237. https://ijemst.org/index.php/ijemst/article/view/611

Gürbüz, M. Ç. (2014). *The effect of PISA mathematical literacy teaching on writing PISA questions and mathematical literacy* [Unpublished Master's thesis]. Bursa Uludağ University.

Handal, B., & Herrington, A. (2003). Mathematics 'teachers' beliefs and curriculum reform. *Mathematics Education Research Journal, 15*(1), 59-69.

Kohar, A. W., Wardani, A. K., & Fachrudin, A. D. (2019). Profiling context-based mathematics tasks developed by novice PISA-like task designers. *Journal of*

*Physics Conference Series, 1200(*1), 012014. https://doi.org/10.1088/1742-6596/1200/1/012014

Kozaklı-Ülger, T., Bozkurt, I., & Altun, M. (2022). Analyzing in-service 'teachers' process of mathematical literacy problem posing. *International Electronic Journal of Mathematics Education, 17*(3), em0687. https://doi.org/10.29333/iejme/11985

Mammadov, R., & Çimen, I. (2019). Optimizing teacher quality based on student performance: A data envelopment analysis on PISA and TALIS. *International Journal of Instruction, 12*(4), 767-788.

Marshall, C., & Rossman, G. B. (2014). *Designing qualitative research*. Sage.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook.* Sage.

Milton, M., Rohl, M., & House, H. (2007). Secondary beginning teacher's preparedness to teach literacy and numeracy: A survey. *Australian Journal of Teacher Education (Online), 32*(2), 37-56.

Ministry of Education [MONE]. (2019). *Ministry of Education [MONE]. (2019). PISA 2018 Turkey preliminary report.* Education Analysis and Evaluation Reports Series.

Mosher, C. A. (2015). *Curriculum redesign with an emphasis on mathematical literacy in an 8th grade function unit* [Unpublished Master's thesis]. The College at Brockport: State University of New York.

National Council of Teachers of Mathematics (NCTM). (1989). *Curriculum and evaluation standards for school mathematics*. Reston, VA: Author.

Organisation for Economic Co-operation and Development. OECD. (2013). *PISA 2012 assessment and analytical framework. Mathematics, reading, science, problem solving and financial literacy.* OECD Publishing.

Organisation for Economic Co-operation and Development. OECD. (2016). *PISA 2015 assessment and analytical framework. Science, reading, mathematics and financial literacy*. OECD Publishing.

Organisation for Economic Co-operation and Development. OECD. (2019). *PISA 2018 assessment and analytical framework*. OECD Publishing.

Özgen, K. (2019). Problem-posing skills for mathematical literacy: The sample of teachers and pre-service teachers. *Eurasian Journal of Educational Research, 19*(84), 179-212. https://doi.org/10.14689/ejer.2019.84.9

Öztürk, N. (2020). *Classification of the high school central exam math questions according to the PISA mathematical literacy levels* [Unpublished Master's thesis]. Sakarya University.

Saenz, C. (2009). The role of contextual, conceptual and procedural knowledge in activating mathematical competencies (PISA). *Educational Studies in Mathematics, 71*(2), 123-143.

Suharta, I., & Suarjana, I. (2018). A case study on mathematical literacy of prospective elementary school teachers. *International Journal of Instruction, 11*(2), 413-424. https://files.eric.ed.gov/fulltext/EJ1174910.pdf

Şahin, O., & Başgül, M. (2018). Examination of pre-service mathematics 'teachers' ability to pose PISA problems. *International Journal of Field Education, 4*(2), 128-148. https://doi.org/10.32570/ijofe.483163

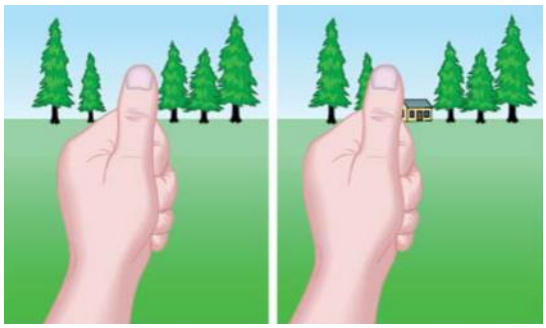
Temel, H., & Altun, M. (2020). The effect of problem-solving strategies education on developing mathematical literacy. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi*, *16*(2), 275-303. https://doi.org/10.17522/balikesirnef.1164584

Appendix

Appendix 1. The Question on ML Designed by T5 in a Scientific Context

PARALLAX (JUMPY FINGERS) METHOD

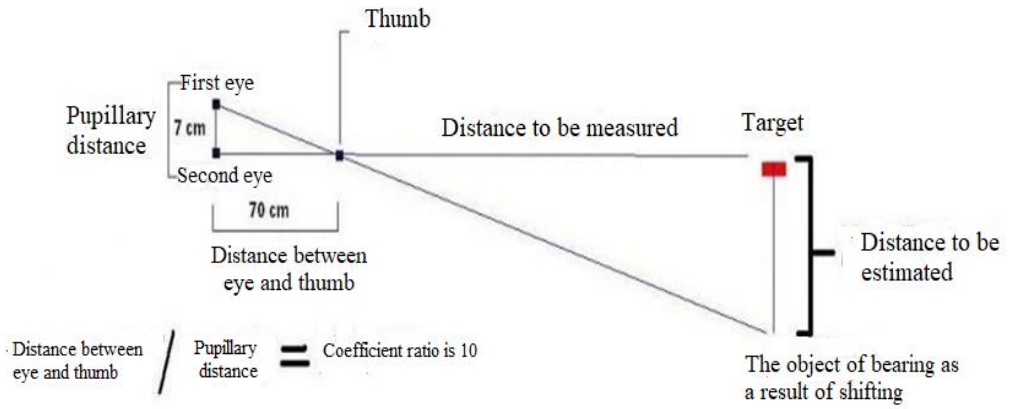
Parallax is the displacement in the position of an object from the observer's point of view. Here, we can make distance estimations using this feature. For example, we need to estimate the distance of a distant house on a plain. We turn our front towards the house and extend one arm parallel to the ground and perpendicular to our torso. Then we close one eye and target the house with our open eyes and thumbs. Then, without moving our hands or heads, we close the open eye, open the closed eye, and look with that eye.



In this case, the image will shift, as seen in the picture above. We estimate how far our thumb has shifted (this distance is easier to estimate) and multiply that by 10. The resulting number will indicate the distance of the house from us. In the example above, if we assume that our finger has shifted 20 meters to the left of the house, then, in that case, the distance of the house is 20X10 = 200 meters.

Question 1: According to the method given above, the difference in the distance between the thumbs in the two images should be shown with the letter "f." We then write the formula that gives the distance of any object we measure from us. (Formulation process)

Question 2:



The parallax method is based on the fact that the base/side ratio of both triangles given above is the same and that the ratio between the arm and the pupil of a normal person is 10 times (The distance between the eyes is 7 cm, and the distance between the eyes and the thumb is 70 cm.) People who want healthier results can find their ratio by

measuring the distance between their pupils and their arm's length. Based on this, if people considering this information measure the pupillary distance as 6 cm, the length of his arm as 70 cm, and the estimated result by moving away the thumb as 85 cm, then what will be the distance when the parallax method is applied? Please show your calculations. (Employing process)

Question 3: If you were making the above measurement for your pupillary distance and arm length, and the distance to be estimated was 40m, how would you find the distance? Explain by drawing triangles (Interpretation-evaluation process)

The pictures used in this question were obtained from: https://dogayakacis.com/2014/05/11/mesafe-tahmin-yontemleri/

Journal of Theoretical Educational Science, 16(3), 641-673, July 2023
Kuramsal Eğitimbilim Dergisi, 16(3), 641-673, Temmuz 2023
[Online]: http://dergipark.org.tr/akukeg
DOI number: http://doi.org/10.30831/akukeg.1257444

Developing Informational Text Writing Skills of Gifted Students by Leveraging Writing Strategies*

Yazma Stratejileri ile Özel Yetenekli Öğrencilerin Bilgilendirici Metin Yazma Becerilerinin Geliştirilmesi

Ömer ERBASAN** **Hakan DEDEOĞLU*****

Received: 27 February 2023 **Research Article** **Accepted:** 23 June 2023

ABSTRACT: Designed as action research, this qualitative study aims to develop the informational text writing skills of gifted students through the strategies of "all about" books and "biography writing frames". The study group of the research consists of 21 gifted 4th-grade students studying in the field of general mental ability in a Science and Art Center in the spring semester of the 2020-2021 academic year. An eight-week action plan was prepared to support the development of these students' ability to write informational texts. The first 4 weeks were planned with the strategy of "all about" books, and the last 4 weeks with the strategy of biography writing frames. The data were collected with student and teacher diaries, observer reports, and student products were scored through Informational Text Writing Rubric. Content analysis was used for the analysis of the collected data. The analysis of the data revealed that while the informational text writing skills of the students were at a moderate level at the beginning, they reached a high level at the end of the process. Based on the findings, some suggestions were presented to teachers and researchers to improve students' ability to write informational texts.

Keywords: Writing skills, all about books, frames for writing biographies, gifted students.

ÖZ: Bu araştırmada "işimiz gücümüz kitaplar ve "biyografi yazma çerçeveleri" stratejileriyle özel yetenekli öğrencilerin bilgilendirici metin yazma becerilerinin geliştirilmesi amaçlanmıştır. Araştırma eylem araştırması deseni ile yürütülmüştür. Araştırmanın çalışma grubunu, 2020-2021 eğitim öğretim yılının bahar döneminde bir Bilim ve Sanat Merkezinde genel zihinsel yetenek alanında eğitim gören 21 özel yetenekli 4. sınıf öğrencisi oluşturmaktadır. Bu öğrencilerin bilgilendirici metin yazma becerilerinin gelişimini desteklemek için sekiz haftalık bir eylem planı hazırlanmıştır. İlk 4 hafta işimiz gücümüz kitaplar, son 4 hafta biyografi yazma çerçeveleri stratejileri ile planlanmıştır. Araştırmanın verileri öğrenci-öğretmen günlükleri ve gözlemci raporları ile toplanmış, öğrencilerin yazdığı metinler "Bilgilendirici Metin Yazma Dereceli Puanlama Anahtarı" ile puanlanmıştır. Toplanan verilerin analizinde içerik analizi kullanılmıştır. Araştırmada öğrencilerin bilgilendirici metin yazma becerilerinin başlangıçta orta düzeydeyken sürecin sonunda yüksek düzeye ulaştığı belirlenmiştir. Araştırma sonuçlarına dayanarak öğrencilerin bilgilendirici metin yazma becerisini geliştirmeye dönük öğretmenlere ve araştırmacılara bazı öneriler sunulmuştur.

Anahtar kelimeler: Yazma becerileri, işimiz gücümüz kitaplar, biyografi yazma çerçeveleri, özel yetenekli öğrenciler, bilgilendirici metin yazma.

* This research was prepared based on the first author's doctoral dissertation.

** *Corresponding Author*: Asst. Prof. Dr., Trakya University, Edirne, Turkey, omererbasan@trakya.edu.tr, https://orcid.org/0000-0001-7852-2747
*** Prof. Dr., Hacettepe University, Ankara, Turkey, dede@hacettepe.edu.tr, https://orcid.org/0000-0003-2436-7010

Citation Information
Erbasan, Ö., & Dedeoğlu, H. (2023). Developing informational text writing skills of gifted students by leveraging writing strategies. *Kuramsal Eğitimbilim Dergisi [Journal of Theoretical Educational Science], 16*(3), 641-673.

ISSN: 1308-1659

Writing has never lost its importance throughout history. Although writing tools and techniques have changed, writing has been at the forefront of humanity's most basic forms of communication. Written expression is one of the most effective tools for an individual to express himself/herself correctly and in accordance with his/her purpose and to communicate. In addition, writing is a critical skill for academic and career success (National Commission on Writing, 2003). Writing skill is a strong predictor of individuals' success in both classroom and business life (Powell, 2009). However, many studies show that students do not have adequate writing skills (Kaptan, 2016; Müldür & Çevik, 2019; Okatan & Özer, 2020; Temel & Katrancı, 2019; Tok & Erdoğan, 2017). Many studies have also concluded that writing studies are not given sufficient attention and time (Bilgin, 2018; Karakoç Öztürk, 2012; Ungan, 2007; Yaylı & Solak, 2014). Not allocating enough time to write is not a problem only in Türkiye. Brindle et al. (2016) found that in the 3rd and 4th grades, teachers spend an average of 15 minutes a day on writing activities, and students write about 25 minutes a day. According to the National Center for Education Statistics (NCES)'s 2011 National Assessment of Educational Progress, nearly a quarter (21%) of high school seniors in the United States do not meet the standards of core competency in academic writing, while only 3% of students are qualified to be considered advanced writers (NCES, 2011).

Writing is a complex endeavor that requires both cognitive skills and linguistic knowledge (Connelly et al., 2012). In addition, different writing genres, such as narrative writing, creative writing, informative writing, poetry writing, and persuasive writing, have their own characteristics, and different techniques are required to write these different genres. Among these, informative texts are the most neglected ones. Therefore, problems in writing skills may manifest themselves more frequently in writing informative texts because it is also known that most of the writing studies in schools progress on narrative texts. While there are many studies on narrative writing and creative writing at primary school level in the literature, the research on informational text writing (Duran & Özdil, 2020; Temel & Katrancı, 2019) is still quite limited. Duke (2011) also stated that in the early years of education, children have little experience reading and writing informational texts.

The focus on informative texts has rapidly increased in developed countries since the 2000s. In particular, Duke's (2000) work was a turning point. Duke found that only 3.6 minutes per day were spent teaching informative text in the first grades he observed, which fell to 1.9 minutes per day in lower socio-economic classes. Yopp and Yopp (2006) found that reading aloud is overwhelmingly narrative in kindergarten to 3rd-grade classrooms. According to Goodwin and Miller (2012), the reading time for genres other than stories is less than 4 minutes in students' daily readings. These striking results increased the interest in informative texts, and recommendations were made that 4th-grade students in the USA should spend half of their reading time on informative texts (National Governors Association Center for Best Practices & Council of Chief State School Officers [NGACBP & CCSSO], 2010). The Common Core State Standards Initiative [CCSSI], 2010) for the language arts, adopted by 45 states in the United States, emphasizes the use of informative texts to help students become researchers while reading. Thus, the importance attached to informative text writing has gradually increased.

According to Aktaş and Gündüz (2005, p.140), an informative text is "a text created to inform the reader, to change or strengthen his/her thoughts and opinions." In Türkiye, it appears that insufficient attention is given to different types of informative texts. There could be several reasons contributing to this situation. According to Akyol (2020), the texts children have the most difficulty with are persuasive and informative because informative texts are complex and challenging by nature. The inclusion of technical words, complex sentence structures, and visual representation of information are examples of some difficulties (Duke & Billman, 2009). The notion that children naturally have a preference for stories over informative texts, find them more enjoyable, and may not be ready for informative texts, could also be one of the reasons for the neglect of informative texts. However, some research results do not support this argument. For example, Smolkin and Donovan (2003) found that young learners, especially boys, are interested in informative books. According to Marinak and Gambrell (2009), informative texts serve as reading motivation for children. The idea that young children are not ready for informative texts has been refuted in many studies (Duke & Tower, 2004; Filipenko, 2004; Smolkin & Donovan, 2003; Yopp & Yopp, 2006).

Problems with writing are not only observed in classrooms with normally developing students. Studies also show that gifted students do not have adequate writing skills or have some problems in writing (Collins & Cross, 1993; Collins & Parkhurst, 1996; Yates et al., 1995). According to Feldman (1993), a high intelligence level is not sufficient for perfect writing. According to Ataman (2011), gifted students behave more reluctantly in writing studies than their peers, which negatively affects their writing attitudes. Şengül (2015) also determined that writing is an area that needs to be developed in gifted students. On the other hand, gifted students have a greater need to write informative texts. Gifted students studying at Science and Art Centers in our country have to write informative project texts in order to participate in research projects such as TÜBİTAK (Turkish National Academy of Science). Due to the researcher's experiences with gifted students and the demands to develop informative text writing skills, which were frequently expressed in interviews with teachers working in these institutions, the research focus was shifted to the development of gifted students' informative text writing skills.

Reviewing the related literature revealed that the research on the writing skills of gifted students in Turkey has been relatively scant. When the available research was examined, it became clear that narrative writing (Bi, 2020; Tetik, 2020; Yaylacık, 2014), creative writing (Özcan et al., 2020; Saluk & Pilav, 2018; Şahin, 2020) and writing anxiety-attitude (Özsoy, 2015) had been the primary focus of research. No research on the development of gifted students' ability to write informational texts in Turkey could be identified.

Reviewing international studies revealed that different strategies and techniques are used for teaching informative text writing. For example, Mathia (2015) used ebooks for teaching informative text writing. Duke (2016) used project-based instruction for teaching informative text writing, and Hebert et al. (2021) used structure instruction. In addition, Antonacci and O'Callaghan's (2012) book "Promoting Literacy Development" includes a section on strategies for teaching informative text writing. It was envisaged that the "all about" books and biography writing frames strategies in this section could

be a solution to the problems experienced by students in writing informative texts. No scientific research using these two strategies was found when the literature was reviewed. However, when the professional material-sharing websites (Teachers Pay Teachers, 2023; The Kinder Corner, 2023) and blogs (All About Books, 2023; Pinterest, 2023) frequently used by teachers were examined, it was seen that teachers frequently used the "all about" books strategy. Therefore, the research focused on these two strategies. These strategies differ from the others in that they are suitable for primary school level, can be easily adapted to grade levels, and offer concrete templates for students to compose their texts.

In the present research, strategies on "all about" books and frames for writing biographies were used to support the development of gifted students' informational writing skills. These strategies are developed to improve students' writing skills. "All about" books strategy offers students the opportunity to write and publish books about the content area they are learning (Antonacci & O'Callaghan, 2012). Antonacci and O'Callaghan (2012) state that with the use of this strategy, students read and discuss the contents of the curriculum, focus on all aspects of a subject they have learned, and write and publish their own books related to the subject. In this way, students are encouraged to read to present ideas on the topic, gain broad knowledge, and choose appropriate information for their book. This strategy consists of five steps. These steps can be listed as choosing a topic for writing, collecting and organizing ideas, writing the book, reading it with the teacher, and sharing it. These steps should not be perceived as steps set in stone. This strategy can be enriched with different steps depending on the students' grade level and writing skills.

Another strategy used in the study is biography frames. This strategy supports students in collecting and organizing information so that they can write biographies (Antonacci & O'Callaghan, 2012). When students begin to write a biography about a person, they need to gather facts about that person's life and organize them in a coherent way. Competent writers use a process of critical inquiry based on posing questions and then seeking answers to those questions (Antonacci & O'Callaghan, 2012). This strategy consists of five steps as well. These steps can be listed as reading a short biography, showing how to use biography frames, presenting students with biographies to choose from, observing students' use of frames while reading, and showing how to use the information to write.

The use of strategies is essential in teaching informative text writing. Novice writers need strategies to decide what to include and exclude from their text, create a text that meets the needs of the target audience, and review and edit a text effectively (Butterfield et al., 1996). For students whose writing skills are not sufficiently developed, strategies that include writing templates can facilitate the process of writing informative texts, which is challenging in nature. For this reason, the learning outcome "applies writing strategies" is included in the Turkish curriculum (MEB, 2019) at all grade levels.

Based on these reasons, our study focused on the development of gifted students' ability to write informational texts, with the problem stated as "Do the strategies of "all about" books and frames for writing biographies support the development of the informational text writing skills of gifted students?" Based on this problem, answers to the following questions were sought in the study.

1. What is the level of gifted primary school students' ability to write informational texts?
2. Does the "all about" books strategy support the development of students' ability to write informational texts?
3. Do the frames for writing biographies strategy support the development of students' ability to write informational texts?

Method

Research Design

This study was designed as action research. Action research is a systematic research approach that enables people to find effective solutions to the problems they encounter in their daily lives (Stringer, 2014). The purpose of action research studies is to improve student achievement and outcomes while improving teacher education (Spaulding & Falco, 2012). The reason why action research is preferred in the current study is that action research is for problem-solving, as this study focuses on solving the problems of gifted students in writing informative texts. Another reason is that action researchers help teachers improve their teaching skills and develop a greater understanding of their students. In addition, the effect of action research on filling the gap between theory and practice and its success in including the teacher (practitioner) in the process is one of the reasons for choosing it. This study may serve as a guide for teachers who aim to improve their students' ability to write informative texts.

Participants

The research was carried out with 21 4th-grade students studying at the Science and Art Center located in the city center of Afyonkarahisar in the spring term of the 2020-2021 academic year. The learning outcome of "Writing informative texts" is only included in the 4th-grade level in primary school in the Turkish Language Curriculum. 56 fourth-grade students are studying at this center. Some of these students continue their distance education optionally due to the Covid 19 epidemic. For this reason, the research was conducted with all of the students (13 boys and nine girls) attending face-to-face education at the center. All of the students volunteered to participate in the research. Four of the students did not receive pre-school education. The students receive education in public schools. Since they are gifted, they attend the Science and Art Center on different days outside of regular school hours. For this reason, the research was carried out with four different groups.

Practitioner Teacher

The practitioner teacher has 15 years of experience teaching in the classroom. She has a doctorate in primary school teaching and has published multiple articles in the field. She attaches importance to academic studies and participates in TUBITAK project competitions with secondary school students in the institution. It is important for her that students are at a sufficient level, especially in project writing. In this sense, she observes that her students have some problems in writing informational texts and thinks that these skills should be improved

Role of the Researcher

The researcher is in the role of the observer in this research. The practitioner became a BİLSEM teacher. The researcher undertook the task of planning the action process, preparing the activities, and evaluating the data. He was also in the practice environment with all the groups during the action process and noted his observations in an impartial way. The researcher was in constant communication with the practitioner teacher about the implementation and functioning of the action plan and guided the teacher to ensure effective research progress.

Data Collection Tools

Observer reports, student and practitioner diaries, student products (informational texts), and the "Informational Text Writing Rubric" developed by Duran and Özdil (2020) were used as the data collection tools. The rubric consists of three dimensions "expression and content," "form," "process," and consists of ten criteria "finding a title," "text sections," "main idea explanation," "supporting idea," "vocabulary," "semantic integrity," "transfer information," "letter legibility," "spelling and punctuation" and "timing." It has four levels "high," "good," "medium" and "low." During the research process, the researcher in the environments the activities were taking place as an observer. The researcher documented the difficulties encountered in practice, the feelings and thoughts conveyed by the students, and the dialogues between the practitioner teacher and the students. The practitioner teacher also kept diaries during the process. The teacher took notes in his diary about whether the activities were completed properly, the points that the students had difficulty with, and what he wanted to change and add to the activity. The students also wrote in their diaries their feelings and thoughts about the implementation process, what the process contributed to them, what they liked, and the areas in which they encountered difficulties.

Intervention Process

An eight-week action plan was prepared to improve gifted students' informational text writing skills. The action plan is presented in Table 1.

Table 1

Action Plan

Strategy	Week	Activity
"All about" books	1	Noticing informative text features: Students are asked to write text in order to see their current status in writing informative texts. Then, the informative and narrative books are examined, and the physical differences between them (cover, visuals, tables, figures, different chapter titles, table of contents, bibliography, etc.) are identified and grouped. By reading both types of books on the same subject, differences in content (writing purposes, language used, realistic information, tables and figures, subtitles, precise information, etc.) are determined. The differences between both types are discussed in detail through examples.
	2	Reviewing "All about Books" examples and preparation for writing: Students are introduced to "All about books" examples, which are good examples of informative text. For this, many examples of All about books are brought to the class and students are asked to review these books. The

		chapters in the book are examined and their functions are emphasized. Students choose a topic for the book they will write. They collect information about the topic they have determined. They are presented with a data graph that they can use to organize the information they collect. The importance of using different resources and the ways to reach these resources are emphasized. The "Informative Text Writing Rubric," where students can see the elements that need attention in an informative text, is examined together with the students.
	3	Writing exercises: Before completing the texts, students present the information they have collected, the subtitles they have determined, and the resources they have reached to their friends. Students evaluate each other on topics and content and make suggestions. With this discussion, the skeleton of the book that the students will write is determined. Students continue to write their texts. Cover, author information page, contents, sections, visuals, graphics or tables, if any, and bibliography are prepared.
	4	Evaluating and sharing the book: Final corrections are made for their books. Each student presents their book to their friends and teachers and completes their books in line with their criticism and suggestions. Completed books are printed out.
Frames for writing biographies	5	Noticing the biography features, using the biography framework: Students write a biography about a person they identify using their prior knowledge. The teacher reads a short biography to attract the attention of the students and chats with the students about this biography. The teacher conducts a class discussion by asking questions such as whether the book interests them, what kind of information it provides about the person, and what aspects of their life affect them the most. S/he brings some examples from the biography books of famous people to the class and asks students to examine these examples. S/he talks to the students about the differences between these biographies and the books they have read before and focuses on what characteristics a good biography should have. S/he asks students to identify a person to write their biography and why they chose that name. S/he asks them to find resources about this person before coming to the next lesson.
	6	Preparation for biography writing: Students are presented with a biography frameworks strategy to guide them by creating a framework for biography writing. The strategy is examined together and how to use it is discussed. A short biography is read and a sample frame is filled in with the students. Students fill in their frames while doing research to find information about the name they have chosen. In this process, detailed information about the person whose biography will be written is collected.
	7	Biography writing: Students continue to write their biography book by completing their framework. Students work on the writing process together by taking the ideas of their friends and teachers. While writing the biography, they are reminded to consider biography features. Students who have completed their biographies are asked to check and make corrections according to the criteria in the Informative Text Writing Rubric.
	8	Evaluating and sharing biographies: Students complete and present their bios to their groupmates and teacher. The aim here is to inform other students about the people whose biographies are written, as well as to receive feedback and suggestions about the biography. During this presentation, students talk about why they chose this person, what they knew about this person before writing a biography and what they learned after writing, why this person most influenced them, and what they

thought as a biographer. Students evaluate each other's biographies and make suggestions. According to the feedback received, students finalize their biographies.

While preparing the action plan, the practitioner teacher was interviewed, and the action plan and activities were prepared in line with the teacher's views and suggestions. The prepared action plan was shared with the validity committee (four professors whose research area is reading and writing) before taking action, the plan was finalized in line with the opinions received, and the action plan was tested through piloting. However, the data from these students were not included in the study. The conclusions reached with the piloting are presented below.

- The specified time (3 lesson hours) for each activity is sufficient.
- Reading informational and biography books takes a long time, and students can be distracted.
- The students wanted to write their biographies in the form of a book, just like the "all about" books.
- The students were observed to generally turn to internet resources to access information.
- Since the students have been continuing their education with distance education for a long time, continuing the activities online will pose no problem when the decision is made to use distance education again.

Based on these conclusions, a summary of the books read during the implementation was made, and the actual implementation was carried out through the summary texts. Biography text writing studies were also updated in the form of writing a biography book in line with the students' requests. In addition, the importance of collecting information from different sources was studied.

Data Analysis

The data obtained from the observer reports, teacher and student diaries were subjected to content analysis, and some sub-themes and themes were obtained through coding. All the informational texts written by the students during the intervention were also analyzed using the Informational Text Writing Rubric. Items 1, 2, 4, and 5 in the scoring key each get 10 points, and items 3, 6, and 7 each get 15 points. The following formula was used to calculate the total score: items 8, 9, and 10 were 5 points each: (1, 2, 4, 5^{th} items total x 5/2) + (3, 6, 7^{th} items total x 15/4)) + (Sum of items (8, 9, 10) x 5/4). The Cronbach Alpha coefficient of the developed rubric was calculated as .83 (Duran & Özdil, 2020). 4 points from the scale correspond to a high level, 3 points to a good level, 2 points to a medium level, and 1 point to a low level.

Validity and Reliability

The validity and reliability of qualitative research differ from quantitative research due to the differences in its paradigm and basic assumptions. While long-term interaction, variation, expert review, and participant confirmation methods can be used for credibility (internal validity) in qualitative studies, detailed description method is used for transferability (external validity). The consistency examination method is used

for the consistency (internal reliability) of the research and the confirmation examination method is used for the confirmability (external reliability).

Longitudinal interaction or observation is significant for understanding, which is the focus of qualitative research. Therefore, the researcher interacted with four different groups for eight weeks and followed the process closely. When considered together, the duration of the face-to-face and distance education observations is almost 80 lesson hours. The observations were recorded impartially by the researcher during this longitudinal interaction.

Different data sources were used to ensure diversity in the research, and the data were collected at different times and reviewed by a different researcher to confirm and correct the findings. Observation, student and teacher diaries, student products, and rubrics were used to diversify the data sources. In addition, since the intervention was carried out with four different groups and the environment of each group was different, environmental diversity was also ensured. Furthermore, researcher diversification was ensured with the participation of an expert researcher in evaluating the research findings.

From the emergence of the research idea, the thesis supervisor and the experts in the thesis monitoring committee helped improve the research with their suggestions at all stages of the research process. In addition, critical evaluation and feedback were received from a teacher who has the expertise to make appropriate judgments about the findings and interpretations based on the findings, who knows the method applied, whose area of expertise is parallel to the study, and who has many years of work experience in Science and Art Centers (with gifted students).

The observation data kept by the researcher was also read to the practitioner teacher, and confirmation from the participant was obtained. Care was taken to transfer the data as it is, and direct quotations were included. The student dialogues with their teachers or among themselves were given a lot of coverage without commenting, and the process was described as much as possible with direct quotations, including those from student diaries.

The results and comments obtained in the research were compared with the raw data to operate a confirmation mechanism. By reviewing the raw data, an external expert examined and evaluated the judgments, comments, and suggestions obtained by the research. In addition, the informational texts written by the students during the action were scored by an expert using the same rubric. The rubric consists of ten items. Considering that 21 students participating in the study wrote four informational texts, the total number of texts examined is 84. As such, the number of items scored for all texts is 840 in total. The reliability = consensus / (consensus + disagreement) formula is used while calculating the agreement between the raters, and it was found to be 92% (=779/779+61). In general, if the result calculated with the reliability formula is above 70%, it is considered reliable.

Ethical Dimension

Adhering to ethical principles is extremely important for the reliability of a research study. Therefore, care was taken to comply with the ethical rules in all steps of the research. At the beginning of the research, the necessary permission and approval were obtained from Hacettepe University Ethics Commission and Afyonkarahisar

Provincial Directorate of National Education (Number E-49809702-605.01-22565992). Participation in the study was completely voluntary. The purpose and process of the research were explained, and the voluntary participation of the students was confirmed before the intervention. For this, the students filled out and signed the Child Voluntary Participation Form. In addition, permission was obtained from the parents of the students that they gave their consent for their children to participate in the research. The parents also filled out and signed the Parent Voluntary Participation Form. During the research reporting, the students' real names were not used, and their personal information was not included. The names used in the research are pseudonyms, and particular care was taken to make sure the pseudonyms did not bear any resemblance to the real names of the participants.

Results

The results are presented in sub-headings according to the research questions.

Results on Students' Informational Text Writing Skills

Before the intervention, the students' status in writing informational texts was determined. The thoughts of the practitioner teacher about the students' ability to write informational texts are as follows:

> … The working logic of Science and Art Centers is quite different from normal schools… We are expected to organize activities with students and participate in some national and international competitions. That is why we need the ability to write informational texts so much. For example, I observe a problem in the students I work with for TÜBİTAK projects. It is necessary to write a report for these projects. Although students are very successful in preparing projects, they have difficulty in reporting it. In other words, students have difficulties in writing informational texts even though they are gifted. They can think of these texts as stories. For this reason, they try to include their feelings and thoughts in their writings. To overcome these challenges, studies on writing informational texts will be very helpful for us (Preliminary interview before the intervention).

To assess the level of informational text writing skills among the gifted students, they were instructed to select a topic they were highly familiar with and write an informational text on that topic prior to the intervention. While doing this, they were reminded to consider the features of informational texts. They were told that they could benefit from the themes and subjects in the Turkish Language Curriculum (MEB, 2019) while choosing the subject. The results revealed by examining the student texts according to the rubric are presented in Table 2.

As can be seen in Table 2, the average of the students is 54.76 out of 100. In other words, the gifted students are at a moderate level in writing informational texts.

A closer look at the criteria in the rubric revealed that the students generally used a general title addressing the subject and did not consider the element of originality. It is observed that most of the examined texts consist of only one paragraph, with no introduction, development, or conclusion. In addition, it was observed that the students started to write their texts without making a mental outline before they started to write. They randomly listed the sentences that came to their minds and kept their texts short in a way that could be considered a summary. In most of the students' texts, the main idea and the subject were not fully explained. Since the main idea was not included in most of the texts, the supporting idea was not included either. Except for

three texts, the vocabulary was insufficient, and overall semantic integrity could not be achieved. In addition, texts lacked sufficient information, or some pieces of information were erroneous. However, attention was paid to spelling and punctuation, except for a few of the texts. Overall, legibility and timing were observed to be good. To sum up, at the beginning of the process, the students were not at a sufficient level, especially in organizing the text parts, giving a clear place to the supporting idea in the text, providing semantic integrity, and presenting rich vocabulary and information. In addition, there were some problems, such as the random ordering of the information in the texts, keeping it short so that it can be considered as a summary, disconnections among the sections of the text, and the inability to achieve semantic integrity.

Table 2

Students Pre-intervention Scores

	Narration and Content							Form		Process	
Text Title	Finding a title	Text sections	Explaining the main idea	Supporting idea	Vocabulary	Semantic Integrity	Transferring Information	Legibility	Spelling and Punctuation	Timing	Score
3D Flight Game	3	1	2	1	1	1	2	2	1	3	41.25
Hide-and-Seek	3	1	2	2	2	2	2	3	3	3	53.75
Brain Test	3	1	1	1	1	1	2	3	3	3	41.25
JMW Dino War	3	3	2	2	2	2	2	2	3	3	57.5
Football	3	2	1	1	1	2	2	3	3	3	47.5
Game	3	2	2	3	2	2	2	3	1	4	57.5
Saturn	3	2	2	2	2	3	2	4	2	3	60
Solar System	3	2	3	2	3	3	3	2	2	3	67.5
Space-1	3	2	2	1	3	2	3	4	3	3	61.25
Space-2	3	3	2	2	4	3	3	3	4	3	72.5
Planets	3	1	2	2	2	2	2	3	3	3	53.75
Telephone	3	2	2	1	2	2	2	3	1	3	51.25
Car Motors	3	2	2	2	4	3	3	4	3	3	70
Design	2	1	1	1	1	1	1	3	3	3	35
Patent	3	2	3	3	2	2	2	2	2	3	60
History of Communication	3	2	2	2	2	2	2	2	2	3	53.75
Wildlife	4	2	3	2	2	3	2	3	1	3	63.75
Fish	3	2	2	2	2	2	2	3	4	3	57.5
I love Math	2	1	2	1	1	1	1	3	3	4	40
Food	3	2	2	1	2	2	2	3	2	2	51.25
Charlie Chaplin	3	2	2	1	2	2	2	3	3	3	53.75
	2.95	1.80	2	1.66	2.04	2.04	2.09	2.90	2.47	3.04	54.76

At the beginning of the intervention, some questions were asked to understand the experience and knowledge of the students on writing informational texts, and all the

students stated that they did not receive any training on writing informational texts and did not know any strategy for it. Only one student stated that he had written an informational text before. In addition, some students were not fully aware of the genre of the text they wrote, and their experience with informational text, in general, was quite insufficient. Below are some excerpts from student opinions.

> Meltem: I don't remember if I have ever written an informational text. I guess I haven't.
>
> Burcu: I wrote a recipe once. Does that count as informational text?
>
> Teacher: Did you use any strategy when writing informational texts?
>
> Yiğit: I didn't. I wrote what came to my mind.
>
> Vedat: We have not received any training on this before. We were just taught that informational texts are texts that give information.
>
> İsmail: When we were in the third grade, we read informational texts. However, a technique on how to write them was not shown.
>
> Mert: I don't know the strategy of writing an informational text. When I write a story, I write without using a strategy.

The researcher's observation regarding the students' situation while writing their texts before the intervention is as follows.

> Before starting to write the text, the students were undecided about what kind of fiction they would write. They had difficulty in outlining their writing. They spent a while thinking about exactly what to write There were students who started the text and thought that it did not exist after a while, asked for new paper, or deleted what they wrote. Some students started writing immediately without any planning. Some students also tried to exchange ideas with each other about what to do while writing informational texts, but they could not help each other. Some students spent so much time deciding what to do that they could only write a paragraph of a few sentences at the end of the time. Some students seemed to get bored of writing. Some students who had difficulty writing informational texts asked the teacher if they could write a story. These questions also show that they were more familiar with story writing. (Observation notes, week 1)

Results of the Intervention Performed by Applying the All About Books Strategy

When the books written by the students were examined according to their subjects, in the process performed with the "all about" books strategy, it was observed that 11 students preferred to write about animals, five students about space, and four students about technology products (Table 3). The results determined according to the rubric on the books written by the students are presented in Table 3.

Table 3

Student Scores on All About Books

	Narration and Content							Form		Process	
A. A. = All About	Finding a title	Text Sections	Explaining the Main Idea	Supporting Idea	Vocabulary	Semantic Integrity	Transferring Information	Legibility	Spelling and Punctuation	Timing	Score
A. A. Airplanes	3	3	3	4	4	3	2	4	4	4	80
A. A.	4	4	3	3	4	4	3	4	3	4	88.

Blue Planet											75
A. A. Octopuses	3	4	3	4	4	4	4	4	2	4	91.25
A. A. Bees	3	4	4	3	4	4	3	3	3	4	88.75
A. A. Football	3	4	3	4	4	4	4	3	4	4	92.5
A. A. Computers	3	3	3	3	3	3	3	3	2	2	72.5
A. A. Butterflies	3	4	4	3	4	4	4	4	4	4	95
A. A. Space Exploration	4	4	4	4	4	4	4	3	4	4	98.75
A. A. Dinosaurs	3	4	4	4	4	4	3	4	4	4	93.75
A. A. Space	3	4	4	4	4	4	4	4	4	4	97.5
A. A. Leopards	3	4	3	3	4	4	4	4	4	4	91.25
A. A. Praying Mantises	3	3	4	3	3	4	3	4	2	3	82.5
A. A. Computer Viruses	3	2	3	4	3	3	2	4	3	2	71.25
A. A. Mysterious Planets	4	4	3	3	4	4	2	4	4	4	86.25
A. A. Robots	3	3	3	3	4	3	3	4	3	4	80
A. A. Elephants	4	4	4	4	4	4	4	4	3	4	98.75
A. A. Snakes	3	4	4	4	4	4	4	4	3	4	96.25
A. A. Lions	3	3	3	3	3	3	2	4	3	2	71.25
A. A. Planets	3	4	3	3	3	4	3	4	3	4	83.75
A. A. Cats	3	4	3	4	4	4	4	3	3	4	91.25
A. A. Cheetahs	3	4	3	4	3	4	4	4	3	4	90

	3.19	3.66	3.38	3.52	3.71	3.76	3.28	3.76	3.23	3.66	87.67

As can be seen in Table 3, the average score of the students, according to the rubric, is 87.67 out of 100. In other words, while the students' informational text writing levels were at a moderate level before the intervention, they reached a high level at the end. The scores of the students increased in all the criteria in the rubric.

The advantages and challenges encountered in the researcher observation notes and teacher diaries in the process carried out with the All About Books Strategy are presented in Table 4.

As stated in the observation notes and teacher diaries, students showed a great interest in writing books. Therefore, a high level of participation and interest in the lesson was observed. At the end of the process, the students understood the difference between informational and narrative texts and made progress in writing informational texts. It was observed that this process also helped students develop positive attitudes towards writing. The students were also reported to have gained the skills needed to use the writing program. It was also observed that the students were in a hurry to write books, they wanted to start writing as soon as possible, so they tried to keep the research process short by turning to internet resources. For this reason, the importance of resource diversity and the importance of using multiple resources during the research was emphasized. The difficulties experienced by some students in using the program during the book writing process were resolved by guiding the students.

Table 4

Advantages and Challenges Expressed in the Observation Notes and Teacher's Diaries during the Implementation of the All About Books Strategy

Advantages	Challenges
• The process of writing a book aroused great interest in students. When the students learned that they were going to write a book, they were highly motivated. Class participation and interest were at a high level. • The students' ability to use a writing program improved. They learned to use features such as preparing covers, adding contents, page numbers, figures, and graphics. • Significant progress has been made regarding informational text writing. Students clearly understood the difference between story and informational text. • Writing a book was a novel and a remarkable experience for students. In this way, students develop a positive attitude towards writing.	• Students found journaling a bit boring as they focused on writing books. • Students had difficulty diversifying the sources while doing research. They generally preferred to do research on the Internet. • They were too hasty in completing the book. • Some students had insufficient computer skills. These students had some difficulty in writing. • Due to the lack of computers and the inability to use a separate classroom, the institution needed preparation every week, which was a bit tiring.

The results obtained from the student diaries in the process of applying the All About Books Strategy are presented in Table 5.

Table 5

Analysis of Student Views on Using the "All About" Books Strategy

Theme	Subtheme	Code	*f*
Development	Writing	Writing an informational text	8
		Authorship	4
		Quick writing	1
	Knowledge	Exploring the differences between text types	11
		Getting informed on the subject	8
	Skill	Researching	6
		Using a program	4
Feeling	Positive	Enjoyable-Fun	13
		Happiness	4
		Feeling like a writer	3
	Negative	Anxiety	1
Difficulty	Technique	Writing program	6
		Internet	1
	Information-data	Accessing and collecting information	5
		Expressing information	2
		Identifying important information	1
	Time	Writing on time	2
Demand	Time	Having extra time	2
	Becoming practical	Writing more	1

Examining Table 5, the students' opinions about the process carried out with the strategy of all about books are grouped under four themes: "development," "feeling," "difficulty," and "demand." Some examples from the student diaries are presented below with the relevant code by direct quotations.

> Elif: I have learned how to write informational texts. I learned what an index is, that there should be things like graphics in informational texts, that information about the author should be written in books, that we should not only get information from internet sites when writing informational texts, and the language of the computer. (Writing an informational text)
>
> Arif: We have gained writing skills. We did research just like a writer. We wrote book chapters, designed covers, and printed books. (Authorship)
>
> İsmail: The informational text has many differences from the story. I didn't know some of these. No false information is given in informational texts. Feelings and thoughts are not mentioned. No heroes or events. These are the most important differences. By paying attention to these, informational text can be written. (Exploring the differences between text types)
>
> Zeki: While researching information to write a book, I have learned more about the space. I did not have such detailed information. I did not know the distances of the planets from each other. I didn't know about dwarf planets. I had no idea how the solar system was formed. (Getting informed on the subject)
>
> Cansu: I have learned to do research. I have done a lot of research on cheetahs. I have tried to gather information from reliable sources. I have learned how to search for information. My research skills have also improved. (Research)
>
> Zeki: I had a hard time finding information from different sources. It might have been easy to copy from the Internet, but we had to do a lot of research to multiply the sources. (Difficulty in accessing and collecting information)

Results of the Intervention Performed by Applying the Frames for Writing Biographies Strategy

Before starting to write a biography, some questions were asked about the students' experiences in writing a biography, and only one student stated that he wrote a biography about himself. It was observed that other students had not written a biography

before. In addition, it was determined that the students had not received any training on biography, and they did not know any technique or strategy for writing a biography.

Before the biography writing process, students were asked to write a biography of a person or a relative whose life they knew about very well. The results emerging from the analysis of the biographies written by the students are presented in Table 6.

As seen in Table 6, 11 students preferred to write a biography of one of their family members or someone in their close social network. Four students preferred to write biographies about an important leader who left an indelible mark on history. Apart from this, six of the biographies are about science, art, sports, and cinema. One student was observed to write his brother's first name, and another to write her sister's full name. To keep the participant information confidential, these names were changed to "my brother" and "my sister".

Table 6

Scores on Biographies Written by Students Before the Intervention

	Narration and Content							Form		Process	
Text Title	Finding a title	Text Sections	Explaining the Main Idea	Supporting Idea	Vocabulary	Semantic Integrity	Transferring Information	Legibility	Spelling and Punctuation	Timing	Score
My Sister	3	2	2	2	3	2	3	3	3	4	63.75
Our Prophet Muhammad	3	3	2	2	4	4	3	4	4	4	78.75
The Man that Makes Us Laugh	4	3	3	3	4	4	3	4	3	4	86.25
Little Rascal	4	3	2	2	4	3	3	4	4	4	77.5
The Great Architect	4	2	2	2	3	3	2	3	4	4	67.5
Biography of My Dad	3	2	2	2	2	2	2	4	4	4	60
My Mom	3	1	1	1	2	1	2	4	4	4	47.5
Nikola Tesla	3	2	3	3	3	3	3	4	4	4	76.25
My Young Brother	3	2	3	3	2	2	2	3	4	4	65
My Brother	3	1	2	2	3	2	2	2	3	4	56.25
Fatih Sultan Mehmet	3	3	4	4	3	4	3	4	3	4	87.5
My Dear Family	4	2	2	2	3	2	2	3	1	4	60
Brother Barış	4	3	3	3	3	3	3	4	4	4	81.25
Prophet	3	3	2	2	4	4	3	4	4	3	77.

Muhammad King Grouch	4	2	3	3	3	3	3	2	2	4	73.75
Reyyan Came	4	2	2	2	3	2	2	2	2	4	60
Mustafa Kemal Atatürk	3	2	3	2	4	2	2	3	2	4	65
Mr. Goal	4	4	4	4	3	4	3	4	4	4	93.75
My Dad is My Friend	4	1	1	1	2	2	2	2	1	4	47.5
My Dear Gokce	4	2	3	2	3	2	2	3	3	4	66.25
Frida Kahlo	3	4	3	2	4	4	3	4	4	4	85
	3.48	2.33	2.48	2.33	3.10	2.76	2.52	3.33	3.19	3.95	70.30

As shown in Table 6, the average student score is 70.30 out of 100. In other words, the levels of gifted students were good before the implementation of the biography frames strategy.

The results of evaluating the biographies written by the students using the rubric are presented in Table 7.

Table 7

Scores on Biographies Written by Students After the Intervention

	Narration and Content							Form		Process	
	Finding a Title	Text Sections	Explaining the Main Idea	Supporting Idea	Vocabulary	Semantic Integrity	Transferring Information	Legibility	Spelling and Punctuation	Timing	Score
Yusuf the Great Wrestler	3	4	3	4	4	4	4	4	4	4	93.75
Marie Curie	3	4	3	3	4	4	4	4	4	4	91.25
The Man that Makes Us Laugh	4	4	3	3	4	4	3	4	4	4	90
Oktay Sinanoğlu	3	4	3	3	3	4	3	4	4	4	85
Mimar Sinan: Master of Masonry	4	4	3	4	4	4	4	4	4	4	96.25
Sinaneddin Yusuf Architect	3	4	3	3	3	4	3	4	3	4	83.75
Sinan Inventor of the Telephone	4	3	3	4	4	4	3	4	4	4	90
Nikola Tesla	3	4	3	3	4	4	3	4	4	4	87.5
Frido	3	4	3	4	3	4	3	4	4	4	87.

Kahlo Master of the Electric: Tesla	4	4	3	4	4	4	4	4	4	4	5 96.25
The Conqueror of İstanbul	4	4	4	4	4	4	4	4	4	4	100
Sultan Suleiman the Magnificent	4	4	4	4	4	4	4	4	3	4	98.75
Brother Barış	4	3	4	4	4	4	4	4	4	4	97.5
İbn-i Sina	3	2	3	2	3	2	2	4	4	3	65
Selçuk Bayraktar	3	4	3	3	4	4	4	4	4	4	91.25
Thomas Alva Edison Biography	3	4	3	4	4	4	4	4	4	4	93.75
Pocket Hercules Naim Süleymanoğlu	3	4	3	4	3	4	4	4	4	4	91.25
Aziz Sancar	3	3	4	4	3	4	3	4	4	4	88.75
Alexander Graham Bell	3	4	3	4	4	4	4	4	4	4	93.75
Louis Pasteur	3	3	3	4	3	3	4	4	4	4	85
The Queen of Painting	4	4	3	3	3	4	3	4	4	4	87.5
	3.38	3.71	3.19	3.57	3.61	3.85	3.52	4	3.90	3.95	90.17

As seen in Table 7, 11 students preferred to write about scientists and inventors, six students preferred to write about artists, and two students preferred to write about athletes and leaders. Two biographies were written by different students about Alexander Graham Bell, Nikola Tesla, Frido Kahlo, and Mimar (Architect) Sinan. The average student score was 90.17 out of 100. In other words, the gifted students' level of writing informational texts was observed to increase to a high level after the implementation of the strategy of frames for writing biographies.

The advantages and challenges noted in the observation notes and teacher diaries in the process carried out with the biography frames strategy are presented in Table 8.

Table 8

Advantages and Challenges Expressed in the Frames for Writing Biographies Strategy Process in Observation Notes and Teacher Diaries

Advantages	Challenges
• Students wanted to write biographies in the form of book. Their interest in writing books was at a high level. • Class participation and interest were at a high level. • Most of the students wrote a biography for the first time. Awareness of the biography genre has grown. • Informational text writing skills improved. • Their ability to search for information has improved. • Awareness was raised about accessing different sources. • They have become eager to rewrite their texts. • Students have gained the ability to evaluate and criticize each other's texts.	• Interaction among students has decreased due to the transition to distance education.

Based on the observation notes and teacher diaries, it was evident that the students exhibited a strong enthusiasm for writing informational books. They were excited to write their own books, resulting in their active participation and high interest in the activities. It was also stated that they developed an awareness of the biography genre, and their skills in writing informational texts improved. A critical step in writing a good informational text is searching for information. It was also observed that the process improved students' research skills and increased their awareness of accessing different sources. However, due to distance education as part of the pandemic measures, interaction between students was limited compared to the period of face-to-face education. The results obtained from the student diaries regarding the Biography Writing Frames Strategy process are presented in Table 9.

When Table 9 is examined, the students' thoughts about the process carried out with the strategy of biography writing frames can be seen to fall under three themes: "development," "feeling," and "difficulty." The themes are similar to the themes that emerged in the process carried out with the strategy of "all about" books, which might be because both processes are about writing informational texts, that is, the processes are similar.

Table 9

Analysis of Student Views on the Frames for Writing Biographies Strategy

Theme	Subtheme	Code	*f*
Development	Writing	Writing a Biography	7
		Writing an Informational Text	3
		Authorship	2
	Knowledge	Self-expression	1
		Getting informed about the person	5
		Learning new words	1
		Research	4
	Skill	Using a computer	4
		Evaluation	2
	Planning	Summarizing	1
		Planning	5
		Planning the time	2
Feeling	Positive	Enjoyable-Fun	11
		Exciting	5
		Scientist	2
		Empathy	1
	Negative	Tiring	1
Difficulty	Information-Data	Finding images	3
		Accessing information	1

Due to the size of the research, a limited number of direct quotations related to the theme and sub-themes were included. Below, some examples from the student diaries are presented with the relevant code by quoting directly.

> Cansu: I have learned the intricacies of writing a biography. First of all, you need to choose the person you will write about carefully and make a good plan. Otherwise, you can get lost in the information. The biography frame has made our job so much easier here. After completing it, it became easier to write. (Writing a biography)
>
> Aylin: I got better at writing informational texts. The more I write, the better my writing gets. I don't make mistakes like I used to. I try to give more information, to make better sentences, and not to make spelling mistakes. (Writing an informational text)
>
> Vedat: We have constantly evaluated each other's work. This has been very helpful. We have had the chance to see the shortcomings in our books. I realized that I learned a lot while criticizing each other. (Evaluation)
>
> Burcu: I gathered a lot of information to write a book. I needed to summarize so much information. Therefore, my ability to summarize has improved. (Summarizing)
>
> İsmail: Biography frames allowed us to act in a planned manner. Because if we think of the biography book as a structure, the biography frame becomes the basis of that structure. (Planning)

The reflections from the teacher's diary about the process are presented below.

> Biography frames have made it very easy for students to write biographies. When they complete the frame, most of the biography they will write is complete. Only some additions and corrections remain. In this sense, I think the frame is quite useful. (Teacher's Diary, Week 8)

The score distribution of all informational texts written by the students is presented in Table 10.

Table 10

Change of Scores

	Average Score
First informational texts	54.76
"All about" books	87.67
First biographies	70.30
Final biographies	90.17

As can be seen in Table 10, gifted students' level of writing informational texts was moderate at the beginning. At the end of the writing process carried out with the strategy of "all about" books, their scores increased to an advanced level. When the first biographies written by the students are examined, they are observed to be at a good level. This is significant in terms of showing students' progress in writing informational texts compared to the beginning of the process. Considering that the students had not written a biography before, it can be said that the information gained in the process with the strategy of "all about" books was transferred by the students to the biographies. At the end of the biography writing frames process, the students reached a high level of 90.17.

Conclusion, Discussion and Suggestions

Students' Informational Text Writing Skills Before the Intervention

At the beginning of the process, the students' ability to write informational texts was at a moderate level. We have not encountered a similar study conducted in Türkiye with gifted individuals that we can directly compare this finding of our study. However, Şengül (2015) found the writing skills of gifted students not to be at the desired level and that writing is an area that needs to be developed in these students. In our research, we observed that when asked to write an informational text, some of the students did not fully remember the informational text features, tried to get help from each other on how to write, and did not enjoy writing a text very much. Ataman (2011) also concluded that gifted students are more reluctant in their writing studies than their peers, which negatively affects their writing attitudes. Master (1983) also mentions that the idea that gifted people have a high level of writing skills is just a misconception. According to Master (1983), what causes this misconception is that these students quickly fill out the exercises in the workbooks or answer the questions in the textbooks faster and more accurately than their peers. However, there is no absolute relationship between these skills and excellence in writing.

There may be many reasons why students are not at a sufficient level in terms of informational text writing skills. One major reason is that informational text writing activities are not given enough space in schools. Before the intervention in the current study, some questions were asked to understand the experience and knowledge of the students on informational text writing, and all of the students stated that they did not

receive any training on informational writing and did not know any strategies about it. Some students were not fully aware of the genre of the text they wrote and their experience with informational texts in general was quite insufficient. Some research results in the literature overlap with these findings. For example, the studies conducted by Ungan (2007), Karakoç Öztürk (2012), Yaylı and Solak (2014), and Bilgin (2018) reveal that inadequate time is allocated to teach writing in schools. This problem is not only experienced in Türkiye. For example, Brindle et al. (2016) found that 3rd and 4th-grade teachers spend an average of 15 minutes a day on writing, and students write about 25 minutes a day. According to the 2011 National Assessment of Educational Progress by the National Center for Education Statistics (NCES, 2011), about a quarter (21%) of high school seniors in the United States do not meet the standards of core competency in academic writing, while only 3% of students are considered advanced level writers.

Intervention Applying the "All About" Books Strategy

After the intervention was carried out with the strategy of "all about" books, the average scores the students got from the texts they wrote reached a high level with 87.67. No study could be identified in the literature using the strategy of "all about" books, to which we can directly compare the results of our study. However, some studies have used different strategies, and progress has been made in writing informational texts. For example, self-regulated writing instruction in secondary school students (Müldür, 2017), students in need of special education (Chalk et al., 2005; Özmen, 2006), and other study groups (Festas et al., 2015; Mason et al., 2006; Uygun, 2012) was found to result in improvement in informational text writing skills. Furthermore, Şener and Kana (2018) used the techniques of making connections between texts and writing introductory chapters in their research, examining the effects of writing techniques on secondary school students' ability to write informational texts. Additionally, Beydoğan (2011) found that brainstorming, clustering, and mind mapping improve students' ability to write informational texts. When international studies on the subject are reviewed, it is seen that different strategies and techniques, such as ebooks for teaching informative text writing (Mathia, 2015), project-based teaching (Duke, 2016), teaching structure (Hebert et al., 2021), and speaking strategy for writing (Corbett & Strong, 2011) are used. The current study differs from other similar studies in that the strategy used is flexible enough to be used at all grade levels and that it organizes and facilitates the process for novice students. Furthermore, with the "All about Books" strategy, an informative book has emerged rather than an informative text. The fact that students' writings turned into a product like a book at the end of the process made them feel like writers and facilitated their development of positive attitudes towards writing. In addition, since the process progressed in the form of writing a book, it became possible to acquire skills such as preparing the cover, contents, index, and bibliography pages and using graphics, tables, and visuals to display the information in an organized manner.

The current study found that students' views on applying the strategy of "all about" books can be gathered under the themes of development, feeling, difficulty, and demand. There are sub-themes of writing, knowledge, and skills under the theme of development. The students state that they have improved in this process in terms of

writing informational texts, authorship, and quick writing. When the informational texts of the students at the beginning of the process and the books they wrote afterwards are compared, it can be clearly seen that they have made significant progress in writing informational texts. Many students participating in the study stated that they wrote informational texts for the first time. The presence of students who stated that they made progress in "quick writing" under the sub-theme of writing also draws attention. When students started to write informational texts for the first time before the intervention, they were observed to spend a significant part of the time thinking about what to write and how to write, failing to use their time effectively, and therefore some of them could not complete their writings. "All about" books strategy, which shows the roadmap of how to write an informational book for students step by step, accelerated the writing process. The use of the writing strategy also prevented the students' writing anxiety, which was manifested by the questions of what to write and how to write. Similarly, in his research aiming to develop the informational text writing skills of secondary school students, Şener (2018) found that students had difficulty deciding on how to outline their writing, how to start writing, and what techniques to use to enhance their writing. In the same study, it was stated that although the students were willing to write, they had difficulties in the entire process of producing informational texts, and they experienced uneasiness because they did not know what to do during the writing process. In their research, in which they tried to determine the writing problems at primary and secondary schools, according to teacher opinions, Tok and Ünlü (2014) concluded that most students had the problem of not making a writing plan.

Regarding the sub-theme of knowledge, the students reported development in discovering the difference between text types and being informed about the subject of the writing. The statements of the students that they discovered the differences between the text types are meaningful in that they show that they are familiar with the narrative genre but do not have full knowledge of the characteristics and structure of the informational texts. At the beginning, it was observed that the students did not have much idea about the informational texts, except that they were informational texts. However, the students discovered the difference between the two text types during the intervention process. They examined the books of both text types and tried to find their differences in form and content. Marinak and Gambrell (2009) recommend examining informational books and having interactive reading-aloud exercises to explore how meaning is created in informational texts.

Under the skill sub-theme, statements regarding the development of research and program use skills are listed. During the intervention process, most students were observed doing internet research on the subject they were to write. For this reason, the importance of diversifying resources was emphasized, and students were advised to use different resources. When the bibliography sections of the books were examined, it was found that although there were a higher number of internet resources on the subject, resources such as books, magazines, and documentaries were also used by the students who tried to diversify their resources. Another observation made in the process is that the students developed their research skills. Students acquired new research skills, such as using keywords in search engines, accessing online journal archives, using indexes, and accessing copyright-free images. Kana and Şener (2021) also revealed that secondary school students realized the importance of research for writing at the end of

their informational text writing activities and that pre-writing research improved their texts. Another skill that the students stated that they acquired in this process is to use writing programs. While some students were good at using the program, some were observed to have just learned some features in the writing program, such as placing figures and pictures, preparing a cover page, and page numbering.

While the students expressed their positive feelings about the process as "enjoyable-fun, ""happiness," and "feeling like a writer," only one student had "anxiety" caused by writing an informational text for the first time. It is very important for students to see the process as fun, to be happy, and to feel like a writer. These thoughts are meaningful because they indicate that students have developed a positive attitude towards writing. Notably, when students heard that they were going to write a text, they were not very happy with it before the intervention, but they had positive feelings at the end of the intervention process. This also shows how important it is to present a strategy that will guide students in their writing studies and to guide them by eliminating the uncertainties in the writing process with various strategies and techniques.

There were also some difficulties with the process. The difficulties most frequently cited by students were technical. Using the writing program and the Internet were some problems experienced. Some of the students stated that they had some difficulties while using the writing program while writing a book. Placing images with text, designing the page, and creating graphics were some of the difficulties mentioned. Some difficulties stand out under the information-data sub-theme, such as "accessing information" and "gathering information," "expressing information," and "identifying important information." The necessary arrangements and activities were made to address all these difficulties in the process of writing the book. Considering that the majority of students wrote an informational text for the first time, it is normal to experience such difficulties. Under the sub-theme of time, it is observed that the opinion of not being able to complete writing within the given time is expressed. One such student who had a problem with time changed the subject and therefore lost a significant amount of time. Another student stated that she could not write as much as she wanted, and the time was insufficient. The students' request for additional time and more practice in writing is noteworthy. To summarize, although the students had some difficulties in applying the strategy of "all about" books, they reported improving their skills, such as writing informational texts, discovering the difference between text types, doing research, and using the writing program.

Intervention Applying the Biography Frames Strategy

The first biographies written by the students were determined to be of a good standard. The knowledge gained by the students on writing informational texts in the process of "all about" books is also reflected in the writing of biographies. The aspects of the biography genre that differ from the "all about" books may have prevented the students from reaching a high-level average by having some difficulties in writing. Despite this, the students were found to have increased their scores in all criteria in biography writing compared to their first informational text. Another point that should be emphasized is that at the beginning of biography studies, students wanted to write biographies in the form of a book, which is significant since it shows that students were

motivated towards writing. In addition, the students wanted to print their books and stated that this made them feel like writers. Supporting this finding, Olthouse (2010) concluded that gifted students are positively affected by the publication of their writings.

Biography is one of the most rarely used genres in Türkiye (Firat, 2012). However, biography is a very effective genre that can be used in teaching many subjects. According to Dedeoğlu (2019), biographies present important role models for children who want to learn about other people. Undervaluing the genre of biography is also evident with the scarcity of scientific studies on biographies in Turkey. Reviewing the related literature reveals only a few studies on the use of biographies. For example, no study could be found that measured the biography writing skills of students in Turkey. However, biographies can also be widely used at the primary school level. For example, Aiesi (2016) conducted a study in which 1st-grade students wrote biographies about their friends and revealed that students in this age group could write successful biographies with the necessary support. Studies highlight the many benefits of using biography in lessons, such as introducing multiple perspectives (Morgan, 2009), content teaching (Murry et al., 2021), and value teaching (Minaz & Taş, 2020).

In the current study, when the biographies completed by the students at the end of the intervention were scored with the rubric, it was determined to be at a high level, with 90.17. Considering that the average score of the first biographies was 70.30, it can be concluded that the students made significant progress in writing biographies. It was determined that the biographies written by the students using the biography writing frames made progress in all dimensions of the rubric compared to the first biographies.

Examining the student diaries, student views on using the strategy of biography writing frames are grouped under three themes: development, feeling, and difficulty. There are four sub-themes under the development theme: writing, knowledge, skills, and planning. The students stated that they made progress in writing biography, informational texts, authorship, and self-expression under the sub-theme of writing. In the sub-theme of knowledge, the students stated that they improved in increasing their knowledge about the person they wrote about and learning new words. Studies (Maloch, 2008; Pappas, 2006; Pappas, Varelas et al., 2003; Webster, 2009) reveal that students who interact with informational texts improve their vocabulary and acquire scientific discourse. Webster (2009) found that using informational texts positively affects the science learning of first-year students. Brabham et al. (2000) concluded that primary school students' content knowledge and vocabulary improved after reading informational books. When the skill sub-theme is examined, it is seen that the students have improved in terms of research, computer use, evaluation, and summarizing. Planning is another area where students report having made progress. Under the sub-theme of planning, student opinions are gathered under planning the writing and planning the time. The students' feelings about the process were gathered under two sub-themes: positive and negative. Under the positive sub-theme, the students stated that the process was enjoyable, and that they felt like scientists and empathized, while under the negative sub-theme, there was a statement that the process was tiring. They also reported difficulties in the process, such as finding images and accessing information.

Another observation in the research is that students helped each other while writing informational texts and improved each other's texts with their suggestions. Aiesi (2016) found that 1st-grade students write more meaningful and in-depth texts when they work with their peers and share their writings. Maloch (2008) states that the use of informational text in the classroom encourages students to participate actively, while Moss (2008) states that it increases meaningful discussions around the text. Maloch and Zapata (2014) also state that interaction with informational texts is a social action for students.

Another key finding emerging in our research is that students in primary school can write informational texts and enjoy them when adequate support is provided. Non-fiction texts are perceived as unusual and challenging for young readers (Maloch & Bomer, 2013). In the past, it was thought that young children could not write informational texts (Wollman-Bonilla, 2000). The idea that students do not want to read informational texts at an early age, that these texts are not suitable for them, and that they cannot write informational texts is wrong. For example, Smolkin and Donovan (2003) found that young learners, especially boys, are interested in informational books. Likewise, Kletzien and Szabo (1998), in their study with students up to third grade, determined that although their teachers predicted that they would prefer stories, students chose books that were as informational as stories for independent reading when they were presented with an option.

In summary, an action plan that included "all about" books and biography writing frames strategies was implemented with gifted students with intermediate level informational text writing skills. These strategies served as the skeleton for the students to construct their texts. Writing strategies are beneficial for students who do not know what to write, where to start, and how to shape their text because it is impossible to write a good text haphazardly. In this sense, both strategies served as a guide for non-professional students in writing, which seems to have helped students gain self-confidence in writing and develop a positive attitude towards writing. Finally, the present study makes an important contribution to the relevant research literature in that it includes easily applicable and adaptable strategies for teachers who want to improve their students' ability to write informative texts, draws attention to neglected genres in Türkiye such as biography, and makes students feel like writers by helping them to create a product (book) at the end of the writing process.

Suggestions

Considering the findings obtained in the research, some suggestions are made for teachers, researchers, and curriculum designers.

Suggestions for Teachers

- Informational text writing practices should be given a stronger focus in schools.
- Classroom discussions examining books representing different text types should be included to allow an exploration of the differences between text types.
- Informational text writing activities should be paid stronger attention to in schools.

- Students should be given sufficient opportunities and guidance to write informational texts.
- Writing studies should be concluded with a product such as a book.
- Students should be encouraged to write on topics of interest and curiosity.
- Different types of informational texts should be included in informational text writing activities. A variety of genres such as biography, criticism, news article, and travel writing can be used easily in classrooms.
- Students should be guided to diversify the sources they use while writing informational texts.
- Students should be given the opportunity to evaluate each other's texts.
- Feedback is very important in the writing process. Evaluation and feedback should not only be product-oriented but should be spread throughout the process.

Suggestions for Researchers

- This study was conducted with gifted students. Similar studies can be conducted with students of normal intelligence and different grade levels.
- In-depth research can be conducted on what kind of changes the strategies used in the research cause in the affective domain (attitude, anxiety, self-efficacy, etc.) in writing informational texts.
- Further research can be conducted to find answers to questions such as how much time is devoted to writing informational texts in schools and the distribution of books in classrooms or school libraries by genre in Turkey.
- Research can be conducted on which text types are preferred by gifted students in reading and writing.

Suggestions for Curriculum Designers

- The outcome "(The student) writes informational texts" is included in the Turkish Language Curriculum (MEB, 2019) for the first time at the 4th-grade level. Learning outcomes related to informational text writing should be included in the curriculum at an earlier age.
- In the Turkish Language Curriculum (MEB, 2019), the text types that should be in the textbooks are specified, and the biography are included in the 7th grade for the first time. Texts such as biography should be included in textbooks at a much earlier age.
- The Turkish Language Curriculum (MEB, 2019) states that one hour of the Turkish course per week should be devoted to writing. Considering that the Turkish course for the 3rd and 4th grades of primary school is eight hours a week, one lesson hour is insufficient for writing practices, which should be extended.

Acknowledgements

This research has been prepared by making use of Ömer Erbasan's doctoral dissertation.

Statement of Responsibility

Author 1: Conceptualization and methodology, writing-original draft preparation, visualization, investigation, data curation, formal analysis, editing. Author 2: Validation, data curation, formal analysis, writing-review and editing, supervision

Conflicts of Interest

No potential conflict of interest was declared by the author.

Author Bios:

Ömer Erbasan completed his doctorate in Hacettepe University Classroom Education Program. He works as a school manager in a public primary school. Reading, writing and children's literature are her main fields of study. He has scientific studies published in national and international peer-reviewed journals and authored chapters in books related to his field.

Hakan Dedeoğlu works at Hacettepe University, Faculty of Education, Department of Basic Education. Reading, writing and children's literature are among the fields of study. Hakan Dedeoğlu has many scientific studies, scientific books and project studies.

References

Aiesi, S. C. (2016). All about us: process-based writing in a first-grade classroom [Master of Arts in Education]. Saint Mary's College.

Aktaş, Ş., & Gündüz, O. (2015). *Yazılı ve sözlü anlatım okuma-dinleme-konuşma yazma* (20. Baskı). Akçağ Yayınları.

Akyol, H. (2020). *Programa uygun Türkçe öğretim yöntemleri* (10. Baskı). Pegem Akademi.

All About Books (2023). https://www.thecurriculumcorner.com/thekindercorner/writingallabout-books/

Antonacci, P., & O'Callaghan, C. (2012). *Essential strategies for teaching writing across the curriculum.* Sage.

Ataman, A. (2011). *Özel gereksinimli çocuklar ve özel eğitime giriş [Children with special needs and introduction to special education].* Gündüz Eğitim Yayıncılık.

Beydoğan, H. Ö. (2011). Effects of mind map supported cognitive preparation on expository writing. *Journal of Kırşehir Education Faculty, 12*(4), 1-23.

Bi, B. (2020). *The effect of self-regulated strategy development model on improving gifted students' story writing skills* [Master's thesis]. Hacettepe Universty, Ankara.

Bilgin, S. (2018). *The situations of application of writing methods and techniques of Turkish teachers in Turkish education program (6th-8th grades)* [Master's thesis]. Mersin Universty, Mersin.

Brabham, E., Boyd, P., & Edgington, W. D. (2000). Sorting it out: Elementary students' responses to fact and fiction in informational storybooks as read-alouds for science and social studies. *Reading Research and Instruction,* 39, 265-290. https://doi.org/10.1080/19388070009558326

Brindle, M., Graham, S., Harris, K. R., & Hebert, M. (2016). Third and fourth grade teacher's classroom practices in writing: A national survey. *Reading and Writing, 29*(5), 929-954. https://doi.org/10.1007/s11145-015-9604-x

Butterfield, E. C., Hacker, D., & Albertson, L. R. (1996). Environmental, cognitive, and metacognitive influences on text revision: Assessing the evidence. *Educational Psychology Review, 8*, 239-298.

Chalk, J. C., Hagan-Burke, S., & Burke, M. D. (2005). The effects of self-regulated strategy development on the writing process for high school students with learning disabilities. *Learning Disability Quarterly, 28*(1), 75-87. https://doi.org/10.2307/4126974

Collins, N. D., & Cross, T. L. (1993). Teaching the writing process to gifted and talented students. *Gifted Child Today, 16*(3), 22–23.

Collins, N. D., & Parkhurst, L. (1996). Teaching strategies for gifted children in the regular classroom. *Roeper Review, 18*, 277–279.

Connelly, V., Dockrell, J. E., Walter, K., & Critten, S. (2012). Predicting the quality of composition and written language bursts from oral language, spelling and handwriting skills in children with and without specific language impairment. *Written Communication, 29*(3), 278-302. https://doi.org/10.1177/0741088312451109

Corbett, P., & Strong, J. (2011). *Talk for writing across the curriculum: How to teach non-fiction writing 5-12 years.* McGraw-Hill Education.

Dedeoğlu, H. (2019). İlkokullarda çocuk kitapları ve dergileri [Children's books and magazines in primary schools]. In M. Gönen (Ed.), *Erken çocukluk döneminde çocuk edebiyatı* [Children's literature in early childhood] (5th ed., pp. 285-304). Eğiten Kitap.

Duke, N. K. (2000). 3.6 minutes per day: The scarcity of informational texts in first grade. *Reading Research Quarterly, 35*(2), 202-224. https://doi.org/10.1598/RRQ.35.2.1

Duke, N. K. (2011). Ask the expert. *The Reading Teacher, 64*(3), 215.

Duke, N. K. (2016). Project-Based Instruction: A Great Match for Informational Texts. *American Educator, 40*(3), 4-12.

Duke, N. K., & Billman, A. K. (2009). Informational text difficulty for beginning readers. E. H. Hiebert & M. Sailors (Ed.), *Finding the right texts: What works for beginning and struggling readers* (pp. 109-128). Guilford Press.

Duke, N. K., & Tower, C. (2004). Nonfiction texts for young readers. J. V. Hoffman & D. L. Schallert (Ed.), *The texts in elementary classrooms* (pp. 125-144). Lawrence Erlbaum Associates.

Duran, E., & Özdil, Ş. (2020). Determining the informative text writing skill levels of fourth grade primary school students. *Research in Reading & Writing Instruction, 8*(1), 21-31. https://doi.org/10.35233/oyea.696288

Feldman, D. (1993). Child prodigies: A distinctive form of the giftedness. *Gifted Child Quarterly, 37*(4), 188-193.

Festas, I., Oliveira, A. L., Rebelo, J. A., Damião, M. H., Harris, K., & Graham, S. (2015). Professional development in self-regulated strategy development: Effects on the writing performance of eighth grade Portuguese students. *Contemporary Educational Psychology, 40,* 17-27. https://doi.org/10.1016/j.cedpsych.2014.05.004

Fırat, H. (2012). Place of children literature in Turkish education: The sample of biography. *Muğla Sıtkı Koçman University Journal of Social Sciences, 29*, 44-56.

Goodwin, B., & Miller, K. (2012). Nonfiction reading promotes student success. *Educational Leadership, 70*(4), 80-82.

Hebert, M., Bazis, P., Bohaty, J. J., Roehling, J. V., & Nelson, J. R. (2021). Examining the impacts of the structures writing intervention for teaching fourth-grade students to write informational text. *Reading and Writing, 34*(7), 1711-1740.

Özmen, R. G. (2006). Uyarlanmış bilişsel strateji öğretiminin zihinsel engelli öğrencilerin yazılı ifade sürecinde kullanılan üstbilişsel strateji bilgisini kazanmalarında etkisi [The effect of adaptive cognitive strategy teaching on students with intellectual disabilities gaining metacognitive strategy knowledge used in the written expression process.]. *Ankara University Faculty of Educational Sciences Journal of Special Education, 7*(2), 49-66. https://doi.org/10.1501/Ozlegt_0000000101

Kana, F., & Şener, G. E. (2021). The effect of writing techniques on middle school students' informative text writing skills. *Milli Eğitim Dergisi, 50*(231), 353-382. https://doi.org/10.37669/milliegitim.737742

Kaptan, A. (2016). *Determine the fifth grade students' persuasive writing skills levels* [Master's thesis]. Eskişehir Osmangazi University, Eskişehir.

Karakoç Öztürk, B. (2012). The study of writing anxiety of the elementary school students in terms of various variables. *Journal of Çukurova University Institute of Social Sciences, 21*(2), 59-72.

Kletzien, S. B., & Szabo, R. J. (1998, December). *Information text or narrative text? Children's preferences revisited.* Paper presented at the meeting of the National Reading Conference, Austin, TX.

Maloch, B. (2008). Beyond exposure: The uses of informational texts in a second grade classroom. *Research in the Teaching of English, 42*(3), 315-362.

Maloch, B., & Bomer, R. (2013). Informational texts and the common core standards: What are we talking about anyway? *Language Arts, 90*(3), 205-211.

Maloch, B., & Zapata, A. (2014). "I'm the leader": Third-graders' meaning-making and social interactions during informational text reading. *Journal of School Connections, 5*(1), 77-102.

Marinak, B., & Gambrell, L. (2009). Ways to teach about informational text. *Social Studies and the Young Learner, 22*(1), 19-22.

Mason, L. H., Snyder, K. H., Sukhram, D. P., & Kedem, Y. (2006). TWA+ PLANS strategies for expository reading and writing: Effects for nine fourth-grade students. *Exceptional Children, 73*(1), 69-89.

Master, D. L. (1983). Writing and the gifted child. *Gifted Child Quarterly, 27*(4), 162-168.

Mathia, K. (2015). Impact of an afterschool science ebook club for gifted and talented elementary students [Doctoral dissertation]. St. John's University, New York.

MEB (Millî Eğitim Bakanlığı) (2019). *Türkçe dersi öğretim programı (ilkokul ve ortaokul 1, 2, 3, 4, 5, 6, 7 ve 8. sınıflar)* [Turkish lesson curriculum (primary and secondary school grades 1, 2, 3, 4, 5, 6, 7 and 8)]. MEB.

Minaz, M. B., & Taş, H. (2020). Effect of biography-based values education on the attitudes of 4th grade primary school students towards the value of patriotism. *Pegem Journal of Education and Instruction, 10*(2), 555–592. https://doi.org/10.14527/pegegog.2020.019

Morgan, H. (2009). Picture book biographies for young children: A way to teach multiple perspectives. *Early Childhood Education Journal*, 37, 219-227.

Moss, B. (2008). The information text gap: The mismatch between non-narrative text types in basal readers and 2009 NAEP recommended guidelines. *Journal of Literacy Research*, *40*(2), 201-219. https://doi.org/10.1080/10862960802411927

Murry, K., Kavimandan, S., Herrera, S. G., & Holmes, M. (2021). Phenomenological research on biography-driven instruction use in highly diverse classrooms. *Teacher Education Quarterly*, *48*(2), 7-23.

Müldür, M. (2017). The effect of self-regulated writing instruction on middle school students' informative writing skills, self-regulated writing skills, and self-efficacy perception [Doctoral dissertation]. Gazi University, Ankara.

Müldür, M., & Çevik, A. (2019). The analysis of secondary school students' informative writing skills. *Journal of Social Sciences of Mus Alparslan University*, *7*(5), 141-149. https://doi.org/10.18506/anemon.520992

National Commission on Writing. (2003). The neglected "R": The need for a writing revolution. The report of the national commission on writing in America's schools and colleges. https://files.eric.ed.gov/fulltext/ED475856.pdf

National Center for Education Statistics (NCES) (2011). *The nation's report card: Civics 2010.* Institute of Education Sciences. U.S. Department of Education. https://files.eric.ed.gov/fulltext/ED519208.pdf

Okatan, Ö., & Özer, D. A. (2020). Describing the writing skills of the first grade elementary school students. *Journal of Mother Tongue Education, 8*(3), 720-731.

Olthouse, J. M. (2010). *Talented young writers' relationships with writing* [Doctoral dissertation]. The University of Toledo, USA.

Özcan, B., Kontaş, H., & Polat, M. (2020). Investigating creative writing skills of gifted and talented students. *International Journal of Turkish Literature Culture Education, 9*(3), 1262-1272.

Özsoy, Y. (2015). *Writing anxiety in gifted secondary school students* [Master's thesis]. Sakarya University, Sakarya.

Pappas, C.C., Varelas, M., Barry, A., & Rife, A. (2003). Dialogic inquiry around information texts: The role of intertextuality in constructing scientific understandings in urban primary classrooms. *Linguistics and Education, 13*(4), 435-482. https://doi.org/10.1016/S0898-5898(03)00004-4

Pappas, C. (2006). The information book genre: Its role in integrated science literacy research and practice. *Reading Research Quarterly, 41*(2), 226-250. https://doi.org/10.1598/RRQ.41.2.4

Pinterest. (2023). All about books. https://tr.pinterest.com/search/pins/?q=all%20about&rs=typed&term_meta%5b%5d=all%7Ctyped&term_meta%5b%5d=about%7Ctyped

Powell, P. R. (2009). Retention and writing instruction: Implications for access and pedagogy. *College Composition and Communication, 60*(4), 664-682.

Saluk, N., & Pilav, S. (2018). Üstün yeteneklilerde yaratıcı yazma becerilerinin geliştirilmesi üzerine bir araştırma [A research on the development of creative writing skills in gifted students.]. *Journal of Kırşehir Education Faculty, 19*(3), 2191-2215. https://doi.org/10.29299/kefad.2018.19.03.011

Smolkin, L. B., & Donovan, C. A. (2003). Supporting comprehension acquisition for emerging and struggling readers: The interactive information book read-aloud. *Exceptionality, 11*(2), 25–38. https://doi.org/10.1207/S15327035EX1101_3

Spaulding, D. T., & Falco, J. (2012). *Action research for school leaders*. Pearson.

Stringer, E. T. (2014). *Action research* (4th ed.). Sage Publications.

Şahin, C. (2020). "Deus ex machina" in creative writing examples of gifted students". *Journal of Mother Tongue Education, 8*(2), 611-627. https://doi.org/10.16916/aded.682529

Şener, G. E., & Kana, F. (2018). The effect of writing techniques on middle school students' informative text writing skills. *Milli Eğitim Dergisi, 50*(231), 353-382. https://doi.org/10.37669/milliegitim.737742

Şengül, M. (2015). The relationship between writing dispositions and intelligence domains of gifted students. *International Journal of Higher Education, 4*(4), 207-215. https://doi.org/10.5430/ijhe.v4n4p207

Temel, S., & Katrancı, M. (2019). The relationship between written expression skills, attitudes towards writing and writing anxiety of primary school students. *International Journal of Euroasian Research, 7*(17), 322-356. https://doi.org/10.33692/avrasyad.590688

Tetik, T. (2020). *Digital storytelling activities in supporting writing skills of gifted primary school students: an action research* [Doctoral dissertation]. Burdur Mehmet Akif Ersoy University, Burdur.

The Kinder Corner (2023). "All about" books: writing unit of study. https://www.thecurriculumcorner.com/thekindercorner/writingall-about-books/

Tok, M., & Ünlü, S. (2014). Evaluation of the writing skill problems in accordance with elementary, middle and high school teachers' opinion comparatively. *Electronic Journal of Social Sciences, 13*(50), 73-95. https://doi.org/10.17755/esosder.04506

Tok, R., & Erdoğan, Ö. (2017). Investigating the Primary School 2nd, 3rd and 4th Grade Students' Skills of Writing. *YYU Journal of Education Faculty, 14*(1), 1003-1024. http://dx.doi.org/10.23891/efdyyu.2017.37

Ungan, S. (2007). Development of and importance of writing skills. *Erciyes University Journal of Social Sciences Institute, 1*(23), 461-472.

Uygun, M. (2012). *The effects of self regulated strategy development on writing expression, self regulation of writing, retention and writing attitude* [Doctoral dissertation]. Hacettepe University, Ankara.

Webster, P. S. (2009). Exploring the literature of fact. *The Reading Teacher, 62*, 662-671. https://doi.org/10.1598/RT.62.8.4

Wollman-Bonilla, J. E. (2000). Teaching science writing to first graders: "Genre learning and recontextualization." *Research in the Teaching of English, 35*(1), 35-65.

Yaylacık, A. (2014). *Highly gifted 5th grade students' narrative text writing skills* [Master thesis]. Mustafa Kemal University, Hatay.

Yaylı, D., & Solak, M. (2014). Views of teachers on the writing activities in middle school textbooks and teacher's books of Turkish language. *Turkish Studies, 9*(6), 1139-1151. http://dx.doi.org/10.7827/TurkishStudies.6624

Yates, C. M., Berninger, V. W., & Abbott, R. D. (1995). Specific writing disabilities in intellectually gifted children. *Journal for the Education of the Gifted, 18*(2), 131-155. https://doi.org/10.1177/016235329501800203

Yopp, R. H., & Yopp, H. K. (2006). Informational texts as read-alouds at school and home. *Journal of Literacy Research, 38*(1), 37-51. https://doi.org/10.1207/s15548430jlr3801_2

Journal of Theoretical Educational Science, 16(3), 674-699, July 2023
Kuramsal Eğitimbilim Dergisi, 16(3), 674-699, Temmuz 2023
[Online]: http://dergipark.org.tr/akukeg
DOI number: http://doi.org/10.30831/akukeg.1199657

Development of Multilingual Preservice Classroom Teachers' Turkish Language Skills: Mind and Intelligence Games

Çok Dilli Sınıf Öğretmeni Adaylarının Türkçe Dil Becerilerinin Geliştirilmesi: Akıl ve Zekâ Oyunları

Fatma Gül UZUNER* **Meral GÖZÜKÜÇÜK****

Received: 4 November 2022 **Research Article** **Accepted:** 11 July 2023

ABSTRACT: The aim of this study was to examine the effect of mind and intelligence games on the development of multilingual preservice classroom teachers' Turkish language skills. In the study, an embedded mixed methods design, which is included in the scope of mixed research designs, was adopted. A single group pretest-posttest design within the scope of the pre-experimental designs was taken as the basis in the quantitative dimension of the research; while in the qualitative dimension, a design related to the effects of the program in the context of a special case study was taken as the basis. The study group of the research consisted of multilingual preservice classroom teachers (n=10). Videos, semi-structured interviews, a questionnaire, diaries, metaphor form, and the Foreign Language Learning Practices Scale (FLLPS) were used as data collection tools. According to the results obtained from the data collection tools, at the end of this game process, the participants' Turkish language skills, cognitive skills (memory, attention, perception, etc.), and affective skills (socialising, feeling happy, having fun, etc.) improved. It was also observed that this development process took place on the basis of cultural interaction. In light of the findings, it was concluded that the mind and intelligence games had positive effects on the development of the multilingual preservice teachers' language skills.

Keywords: Turkish language teaching, language skills, multilingualism, mind and intelligence games.

ÖZ: Bu çalışmada, çok dilli sınıf öğretmeni adaylarının Türkçe dil becerilerinin geliştirilmesinde akıl ve zekâ oyunlarının etkisinin incelenmesi amaçlanmıştır. Araştırmada karma araştırma desenleri kapsamında yer alan iç içe karma yöntem deseni benimsenmiştir. Bu bağlamda, araştırmanın nicel boyutunda deney öncesi desenler kapsamında yer alan tek grup öntest-sontest deseni; nitel boyutunda ise özel durum kapsamında programın etkisi deseni esas alınmıştır. Araştırmanın çalışma grubunu yabancı uyruklu çok dilli (n=10) sınıf öğretmeni adayları oluşturmaktadır. Veri toplama aracı olarak video, yarı yapılandırılmış mülakat, anket, günlük, metafor formu ve Yabancı Dil Öğrenme Uygulamaları Ölçeği (YDÖUÖ) kullanılmıştır. Bu oyun sürecinin sonunda veri toplama araçlarından elde edilen sonuçlar doğrultusunda katılımcıların Türkçe dil becerilerinin (dinleme/izleme, konuşma, okuma, yazma), bilişsel becerilerinin (hafıza, dikkat, algı, vb.) ve duyuşsal becerilerinin (sosyalleşme, mutlu hissetme, eğlenme, vb.) geliştiği sonucuna ulaşılmıştır. Bu gelişim sürecinin kültürel bir etkileşim zemininde gerçekleştiği de görülmüştür. Bu gelişim sürecinin (dilsel, bilişsel, duyuşsal ve kültürel) ise deneyimsel öğrenme bağlamında gerçekleştiği sonucuna da ulaşılmıştır. Elde edilen bulgular ışığında, akıl ve zekâ oyunlarının çok dilli öğretmen adaylarının dil becerilerinin geliştirilmesi noktasında olumlu etkileri olduğu sonucuna ulaşılmıştır.

Anahtar Kelimeler: Türkçe dil öğretimi, dil becerileri, çok dillilik, akıl ve zekâ oyunları.

* *Corresponding Author*: Asst. Prof. Dr., Kafkas University, Kars, Türkiye, fgu61@hotmail.com, https://orcid.org/0000-0001-8483-6021
** Asst. Prof. Dr., Manisa Celal Bayar University, Manisa, Türkiye, meralyaprak@gmail.com, https://orcid.org/0000-0002-1620-5073

Citation Information
Uzuner, F. G., & Gözüküçük, M. (2023). Development of multilingual preservice classroom teachers' Turkish language skills: Mind and intelligence games. *Kuramsal Eğitimbilim Dergisi [Journal of Theoretical Educational Science]*, *16*(3), 674-699.

ISSN: 1308-1659

Play is an important tool in the development of a child's linguistic, social, cognitive, and self-regulation skills (National Association for the Education of Young Children [NAEYC], 2021). Play enables students to develop their language skills and helps in building the vocabulary and grammar that support these skills (Kara, 2010). Intelligence games can be utilized in the process of developing language skills through play. Intelligence games can be defined as activities offered for individuals realize their potential, to make quick and correct decisions, produce their own specific solutions to problems, and renew themselves (Devecioğlu & Karadağ, 2014). In this sense, mind and intelligence games can contribute to the development of individuals' language skills.

It is known that intelligence games develop many skills in students. From this point of view, the significance of this research lies in students playing intelligence games in the classroom environment together with their friends and learning while having fun. Within this scope, this study can enable students to like school more and to be more successful academically. It can be stated that the research is important in terms of contributing linguistically, cognitively, affectively, socially, and culturally to multilingual preservice teachers in the Turkish teaching process. The number of studies aimed at teaching Turkish through games to multilinguals is limited.

Literature Review

Schools are strong literacy providers and help to determine what ranks as the appropriate language to be conveyed through literacy practices (Baker, 2011). Since all language processes, namely reading, writing, listening, and speaking processes, are interrelated and support each other, they should be developed holistically (Garcia, 2009). Language skills are developed holistically both while learning the first language and in the process of learning a second or foreign language. An individual's native language can also be expressed as their first language. Knowing only one's mother tongue throughout one's life may not be enough to sustain one's life. Individuals may have to learn languages different from their mother tongue due to various reasons such as business life and education. People may wish to learn different languages in order to travel to other countries. Expressing language as a first language, second language, or foreign language varies according to usage situations. Furthermore, there are cases of bilingualism and multilingualism. According to Butler (2014), multilingualism defines the use of more than two languages.

The coexistence of different languages in a community or an individual requires three things: the existence of different languages, the opportunity for different languages to communicate with each other, and the ability of people to learn and use more than one language (Wei, 2014). Second language acquisition is a process in which most of the world's population actively takes part for many reasons. A few situations that lead to the need or desire to learn another language include immigration to a new country, work demands, the desire to have the skills to converse with people from another culture or ethnicity or fulfilling academic program requirements. Such situations will continue to encourage individuals from all walks of life to engage in language learning (Hummel, 2014). Many studies on bilingualism involve immigrants, and if the participants in these studies feel that they do not receive any feedback about the results of the study, they may become discouraged from taking part in the study (Lanza, 2010). The self-esteem and identity of language-minority children may be affected by the

literacies that are legitimized and those that are ignored or scorned by the school (Baker, 2011).

Comparisons between the best performances of individuals in the first language and in the second language have shown that the performance in one language, even if that language is the dominant language, is not an accurate reflection of the child's semantic development level, and in the evaluation of bilingual individuals, it is most accurate if the individuals combine their best performance in both languages (Marian, 2013). In bilingual schools, individuals can develop their studies in areas like art, science, social science, mathematics, etc., not only in their mother tongue but also in the international language, but these individuals understand the international language as the one used in educational contexts that give instruction in more than one language, and this differs from the languages officially accepted in the country; that is, this language has a cognitive, social and cultural value (Liberali, 2013). Children who speak two languages are exposed to both cultures. These cultures, like languages, can be relatively similar or different from each other (Paradis et al., 2011). Children who learn the languages of two very different cultures have a double learning task: they must learn not only both languages but also how to use each language in culturally appropriate ways (Paradis et al., 2011). In multilinguals, this involves learning more than two languages and interacting with more than two cultures. In addition, there are a number of variables that show the extent to which either the first language or the second language will affect the acquisition of the third language (Gass et al., 2013), such as proficiency in the known languages, user age, and linguistic proximity of these languages.

The Turkish language can be taught in the form of:

• Teaching Turkish as the native language, that is, as the first language,

• Teaching Turkish to those living in Turkey whose mother tongue is not Turkish, that is, as a second language,

• Teaching Turkish to foreigners, or

• Teaching Turkish to Turkic peoples.

Since the nationalities of the participants in this study are Turkmen and Uzbek, the participants consist of students of Turkic origin. Normally, this study should be considered as teaching Turkish to Turkic people. However, since the participants stated that they knew more than two languages, it is considered as teaching Turkish to multilinguals.

The greater the number of sensory organs involved in the learning process, the more activities and games that activate all stimulants should be included in teaching Turkish to foreigners so that learning will be more accurate and permanent (Gürsoy & Arslan, 2011). It has been determined that the use of games in foreign language teaching not only facilitates and accelerates language learning but also enables students to have fun, participate lovingly and willingly in classes, be active, and retain what they have learnt (Kara, 2010).

One of the methods and techniques used in the development of language skills is educational games (Alver, 2019). In fact, playing contributes to the development of language skills (Güneş, 2015). Play is exciting; it is an experience (Winnicott, 2017). According to Huizinga (2006), play is a voluntary activity that requires order, has a

purpose, and differs from routine life. Play is liberating, and exhilarating is defined more as a verb than a noun. In this sense, the act of playing is something that an individual experiences and creates (Scarlett et al., 2005). Furthermore, play is enjoyable and, at the same time, a learning experience (Cohen, 1993). Thus, many types of this experience can be identified (Sheridan, 2011). According to Roberts and Sutton-Smith (1962), games can be classified into three groups as physical games, strategy games, and games of chance. Among these, strategy games consist of games that involve only strategy (chess, draughts, Go, etc.) and games that require a combination of strategy and luck (bridge, cribbage, etc.). Accordingly, mind and intelligence games can be considered within the scope of strategy games.

Intelligence involves the use of many skills, such as verbal comprehension and fluency, numerical ability, memory, and perceptual speed (Turkish Intelligence Foundation, 2021). The mind, on the other hand, is "the part of a person that makes it possible for him or her to think, feel emotions, and understand things" (Cambridge Dictionary, 2021). According to Descartes' philosophy, the mind is the element that enables us to be aware of other things (Smith & Jones, 1997). Thus, intelligence games enable students to get to know themselves, form a systematic mindset, generate creative solutions, make quick and accurate decisions, develop their perception and evaluation skills, improve their ability to work together or individually and compete, and realize their own hidden strengths (Ministry of National Education [MNE], 2013). In fact, playing is one of the oldest learning approaches (Coleman, 1976), and educational games fall within the scope of active learning (Güneş, 2015). While students are actively learning, they are lively, cheerful, willing, and constructors of knowledge (O'Neill, 2016), and playing games requires using language and intellect (Güneş, 2015). Since students undergo an active and passive experience process (Dewey, 2004), playing games is related to learning by doing and experiencing. Silberman (2016) states that skills can be developed through learning by experiencing, Avedon and Sutton-Smith (1971) also state that students learn while playing games. Games can be used as a strategy in language education and to develop students' language skills in an entertaining way without age restrictions (Birova, 2013). Based on this, mind and intelligence games can be utilized to improve the Turkish language skills of multilingual students. There are many types of mind and intelligence games, and the Mangala, Look Look, Pentago, Equlibrio and Qbitz games are some examples of these.

First of all, this study, which was conducted to improve the language skills of multilingual individuals, will contribute to the international language, culture, and games literature. As a matter of fact, in the globalising world, language problems experienced by multilingual individuals are a universal problem, cultural interaction is inevitable, and games are a universal way of learning and teaching. On the other hand, the number of experimental and mixed studies on teaching Turkish to foreigners is low (Biçer, 2017), and there are very few studies (Aşuluk, 2020; Güneş, 2021; Şen, 2020) in which mind and intelligence games are used for this purpose, the research may also contribute to the literature in this sense. It was stated that the studies on mind and intelligence games were mostly studied with primary and secondary school students (Özdevecioğlu & Hark Söylemez, 2021). Therefore, the present research is valuable in both these aspects. The aim of this research is to examine the effect of mind and intelligence games on the development of multilingual preservice classroom teachers'

Turkish language skills. Within the scope of this aim, an answer is sought to the question, "What is the effect of mind and intelligence games on the development of multilingual classroom teacher candidates' language skills?". Turkish language skills of the participants were evaluated in the context of the pretest and posttest, their views on teaching Turkish were obtained through mind and intelligence games. The diaries they kept during the implementation process were evaluated, and the questionnaire and metaphor forms were also used.

Method

This study utilized a nested mixed method design (Creswell & Plano-Clark, 2011), which is within the scope of the mixed research designs since a qualitative process was included in an experimental research process. Within the scope of quantitative designs, a single group pretest-posttest design (Creswell, 2014), which is one of the pre-experimental designs, was used. A case study design (Datta, 1990) related to the effects of the program was taken as the basis to provide stronger explanations for the effect of the experimental process. The pre-experimental part of the research was supported by the case study process. In other words, the qualitative process was used to support and deepen the quantitative process. For this reason, the effect of mind and intelligence games on language skills has been tried to be seen in an inclusive way.

Criterion sampling (Patton, 2002) and convenience sampling (McMillan & Schumacher, 2014) techniques were used as the basis for the creation of the study group of this research. Preservice classroom teachers who were foreign nationals and multilingual were contacted. In the context of convenience sampling, volunteers from among the contacted preservice teachers were included in the research, and the study group of the research was formed. Information about the study group is given in Table 1.

Table 1
Information Related to the Study Group

Participants	Gender	Age	Nationality	Mother tongue/Language of instruction	Other languages known	Level of languages known	Time spent learning Turkish (years)
P1	Female	20	Uzbek	Turkmen Turkmen	Uzbek Turkish Kazakh Russian English	Intermediate Intermediate Advanced Elementary Elementary	2 years
P2	Female	19	Uzbek	Turkmen Turkish	Turkish Uzbek Russian English	Intermediate Advanced Intermediate Intermediate	1 year
P3	Female	23	Uzbek	Turkmen Turkmen	Uzbek Turkish Russian Kazakh	Advanced Intermediate Advanced Intermediate	3 years
P4	Female	19	Turkmen	Turkmen Turkmen	Turkish Russian	Intermediate Intermediate	2 years

P5	Female	21	Turkmen	Turkmen	Russian	Intermediate	1 year
				Turkmen	Turkish	Elementary	
P6	Male	27	Uzbek	Uzbek	Turkish	Intermediate	5 years
				Turkmen	Turkmen	Intermediate	
					Russian	Elementary	
					Kazakh	Elementary	
P7	Male	25	Turkmen	Turkmen	Turkish	Intermediate	4 years
				Turkmen	Uzbek	Intermediate	
					Russian	Elementary	
					English	Elementary	
P8	Male	24	Turkmen	Turkmen	Turkish	Intermediate	4 years
				Turkmen	Russian	Elementary	
					German	Elementary	
P9	Female	26	Turkmen	Turkmen	Turkish	Intermediate	4 years
				Russian	Russian	Intermediate	
P10	Female	19	Turkmen	Turkmen	Russian	Advanced	1 year
				Turkmen	Turkish	Advanced	
					English	Intermediate	
					Uzbek	Intermediate	

Table 1 shows the participants' gender, age, and mother tongue, the other languages that they know, the level of these languages, and the duration of learning Turkish. All of the participants live in Turkey and are in their first year of studying at the university. They had previously lived in Turkmenistan. Languages spoken by the participants other than their mother tongue were Uzbek, Turkish, Kazakh, Russian, English, Turkmen, and German. The participants stated that they learned Turkish through university, the social environment, and social media.

Data Collection

Video: One of the qualitative data collection approaches used within the scope of audio-visual materials is videos (Creswell, 2013). In this research, the video recordings were made using cameras in every implementation, and the video recordings were stored appropriately.

Diary: The diary is a type of document (Robson, 2011). A participant's keeping a diary as part of the research is also one of the qualitative data collection approaches within the scope of documents (Creswell, 2013). In fact, although individual documents are written with a subjective approach, they can provide reliable information about individuals on certain issues (Merriam, 2009). In this study, the participants kept a diary at the end of each application. The diaries written by the participants were examined by the researchers.

Semi-structured interview: In this research, the semi-structured interview technique was used, which involved asking interview questions (Merriam, 2009). The interview questions consisted of three parts in this study. In the first part, the participants were asked about their education and Turkish learning processes in Turkey. In the second part, their views were sought on the implementation process designed based on mind and intelligence games. In the third part, their opinions on the development of the implementation process were collected. While preparing the semi-structured interview questions, opinions were received from a total of three experts working in the field of language, game, and mixed research. The interview questions were prepared within the framework of the feedback given by the experts. A pilot study of the semi-structured interview questions was conducted with three foreign students

who participants in the main study were not. As a result of this, the semi-structured interview questions were given their final form.

Metaphor form: The participants were asked to fill in the blanks in the sentence, "Teaching Turkish with mind and intelligence games is like/similar to…, because…". In fact, metaphors can be used in order to add meaning to experiences (Miles & Huberman, 1994). The metaphor form was used to support other qualitative data.

Questionnaire: The questionnaire is one of the frequently used data collection tools to learn people's opinions about the level of their satisfaction with a new service, product, or program (Fink & Kosecoff, 1985). In this research, the questionnaire consisted of a total of 15 questions, of which six were open-ended, and nine were closed-ended. For the closed-ended questions, grading-type questions were used. The questions were graded as 1 ("I am not competent"), 2 ("I am somewhat competent"), 3 ("I am moderately competent"), 4 ("I am competent"), and 5 ("I am very competent"). The content of these questions was related to the participants' Turkish language skills and game-playing skills. In this regard, support was received from an expert who had published studies on questionnaires. The survey questions were organized within the framework of the feedback given by the expert. A pilot study of the semi-structured interview questions was conducted with three foreign students who participants in the main study were not. As a result of this, the survey questions were finalized.

Foreign Language Learning Practices Scale (FLLPS): This scale was developed by Yeşil (2018). The research was carried out with 653 students who received Turkish language preparatory instruction at the Kyrgyz-Turkish Manas University (KTMU). Validity (exploratory factor analysis, discriminant analysis) and reliability (internal consistency, stability) analyses of the scale were performed. The scale has six factors, which are "General Learning Practices (GLP), Speaking Learning Practices (SLS), Reading Learning Practices (RLP), Writing Learning Practices (WLP), Grammar Learning Practices (GrLP), and Listening Learning Practices (LLP)" (Yeşil, 2018). The scale is graded on the basis of 0 (Never), 1 (Rarely), 2 (Sometimes), 3 (Often), and 4 (Always). The KMO value of the FLLPS was 0.881; the Bartlett test values were $x2=3949.698$; $sd=435$; $p<0.000$. The items in the scale explained 49.65% of the total variance, and the Cronbach alpha reliability coefficient of the overall scale was 0.880 (Yeşil, 2018).

The data collection process of the research was as follows:

1. Within the scope of the pretests, the questionnaire and FLLPS were applied to the participants.

2. Following the pretests, 10 implementations were made over a total of five weeks, for 2-3 hours per week.

3. Within the scope of the implementations, one mind and intelligence game was determined for each week. While determining the mind and intelligence game, the skills to be developed by the selected game, the skills desired to be developed, and the age range of the target group of the relevant game were taken into consideration. The rules, visuals, and materials of the determined game were prepared before the implementation. The selected game was processed like a Turkish text during the implementation process. In the first stage, listening,

speaking, and reading activities were carried out, and immediately afterwards, the participants were required to play the relevant game. The participants wrote down their feelings and thoughts about the game process in their diaries. Finally, the researchers read the participants' diaries together with them and gave them feedback (on language, expression, spelling, etc.). The implementation process was recorded with a camera.

4. The names of the games used in the application are as follows: Mangala, Look Look, Pentago, Equlibrio, and Qbitz.

5. Within the scope of the posttests, the questionnaire and FLLPS were applied to the participants, and semi-structured interviews were conducted with the participants. In this way, the research process was concluded.

6. One of the researchers is an expert in language education for multilingual students, while the other is an expert in mind and intelligence games.

Data Analysis

The data obtained from the diaries, videos, and semi-structured interviews, which are the qualitative data collection tools, were subjected to the thematic coding approach. The thematic coding approach can be used as a constructivist method of investigating the experiences of participants (Robson, 2011). Based on the stages of this method (Robson, 2011), the data were first transcribed and read repeatedly, draft codes were created, and all the data were coded in the same way. Following the coding, the themes were determined, and the relationships between the themes were revealed. Finally, the data were integrated, and interpretation was conducted. The researchers worked simultaneously in the analysis process of the qualitative data. Since the data obtained from the FLLPS, which is the quantitative data collection tool, did not fully meet the parametric test assumptions, they were subjected to the Wilcoxon signed-ranks test, which is one of the non-parametric tests (Salkind, 2011). In terms of the quality of the research, the support of experts as external auditors was sought (Creswell, 2014). Furthermore, metaphors and counting processes (such as frequency) were utilized, comparisons were made, pieces of data were organized into a whole, an attempt was made to establish conceptual consistency and to control possible researcher effect, triangulation was made, and standards related to the quality of the results were taken into consideration (Miles & Huberman, 1994).

Results

The Turkish Teaching Process with Mind and Intelligence Games

In this section, the findings obtained as a result of the analysis of the data obtained from the videos and diaries are included. The order of discussing the findings is in the form of videos and diaries, respectively. The findings related to the process before the texts and games are given in Table 2.

Table 2

Findings Related to the Process Before the Texts and Games

Process		Before the Game					
Mind and Intelligence Games Theme and codes		Mangala	Look Look	Pentago	Equlibrio	Qbitz	Frequency
Theme: Before the Text: Process Focused on Listening and Speaking Skills	Attention-getting and motivation activities were conducted.	✓	✓	✓	✓	✓	5
	Participants were made aware of the target.	✓	✓	✓	✓	✓	5
	Participants' preliminary information about the game was checked.	✓	✓	✓	✓	✓	5
	The materials were introduced to the participants.		✓	✓		✓	3
	A sample implementation was shown to the participants.		✓	✓		✓	3
	The participants examined the concrete materials of the game.	✓		✓	✓		3
	The participants did visual reading.	✓	✓	✓	✓	✓	5
	The participants used a digital dictionary.	✓					1
	Exercises on keywords were done with the participants.	✓					1
	The participants were asked to guess the content of the game.	✓	✓				2
	The participants were given hints about the content.	✓	✓	✓	✓	✓	5

Note: The codes are listed in order of implementation.

Table 2 shows the general outlines of the participants' process before the texts and games. Accordingly, activities related to listening and speaking skills were conducted with the participants before the texts and games.

Following the process before the texts and games, the findings related to the process are given in Table 3.

Table 3

Findings Related to the Process During the Texts and Games

Process		During the Game					
Mind and Intelligence Games Theme and Codes		Mangala	Look Look	Pentago	Equlibrio	Qbitz	Frequency
Theme: During the Text: Process Focused on Listening, Speaking and Reading	The participants were asked to silently read the informative text about the game.	✓	✓	✓	✓	✓	5
	The participants were asked to identify words whose meanings they did not know during reading.	✓	✓	✓	✓	✓	5
	A sample reading was made aloud by the researchers.	✓	✓	✓	✓	✓	5
	The participants were allowed to engage in shared reading aloud.	✓	✓	✓	✓	✓	5
	The participants were asked to demonstrate what they read	✓			✓		2

in practice.						
Practical information was given by the researchers about the parts of the text read.		✓	✓		✓	3
Vocabulary development exercises were carried out.	✓	✓	✓		✓	4
Explanations were made regarding the use of spelling and punctuation marks.	✓		✓			2
The participants were asked to summarise the game text that they read.	✓		✓			
The participants were asked reading comprehension questions about the game text.	✓	✓	✓	✓	✓	4
A game was played with a student in order to demonstrate the game rules.	✓		✓	✓		3
The participants were divided into groups and played games among themselves.	✓	✓	✓	✓		4
While playing the game, issues related to daily life were discussed with the participants.	✓	✓	✓			3
While playing the game, the participants talked among themselves about the game and daily life.	✓	✓	✓			3
It was observed that the participants were cheerful and had fun while playing the game.	✓	✓	✓	✓	✓	5
It was observed that the participants joked with each other and the researchers while playing the game.	✓	✓	✓	✓		4
The participants' game process was observed by the researchers, the participants were guided where necessary, and relevant feedback was given.	✓	✓	✓		✓	4
The participants were asked questions by the researchers about the strategies they developed in the game and hints were given in a way that would not break the equality.	✓	✓	✓			3
After the games were fully understood by the participants, mini tournaments were held for the relevant game.	✓	✓	✓	✓	✓	5
Regarding the tournaments, it was observed that the participants were a little more tense compared to the learning process but still cheerful.	✓			✓		2
Most of the participants verbally stated that they liked the game and had fun.	✓	✓	✓			3
It was observed that the participants played carefully by thinking, developing strategies and reasoning during the game process.	✓					1
It was observed that the game had interdisciplinary benefits.	✓	✓		✓	✓	4
The participants tried to play the game by using their visual perception skills.		✓		✓	✓	3
It was observed that there was cultural interaction between the researchers and participants.	✓	✓	✓			3

Note: The codes are listed in order of implementation.

Examining Table 3, the general outlines of the participants' process during the texts and games can be seen. Within the scope of the process during the texts and games, activities were conducted with the participants related to listening, speaking, and reading skills.

Finally, the findings related to the participants' process after the texts and games are given in Table 4.

Table 4

Findings Related to the Process After the Texts and Games

Process		After the Game					
	Mind and Intelligence Games Theme and Codes	Mangala	Look Look	Pentago	Equlibrio	Qbitz	Frequency
Theme: After the Text: Process Focused on Listening, Speaking, Reading and Writing Skills	The participants were asked to write an article describing the rules of the game and their feelings and thoughts about the process.	✓	✓	✓	✓	✓	5
	The participants' articles were simultaneously examined by the researchers and feedback was given to the students.	✓	✓	✓	✓	✓	5
	The researchers worked one-on-one with students.	✓	✓	✓	✓	✓	5
	The researchers' feedback was concerned with rules related to spelling and the use of punctuation marks, and vocabulary.	✓	✓	✓	✓	✓	5
	The researchers used plain language as much as possible while giving feedback to the students.	✓	✓	✓	✓	✓	5
	Communication between the researchers and students took place in a way that included listening, speaking, reading and writing skills.	✓	✓	✓	✓	✓	5
	The students rewrote their articles within the scope of the feedback they received from the researchers.	✓	✓	✓	✓	✓	5
	The articles revised by the students were examined by the researchers for the last time, and the writing process was completed.	✓	✓	✓	✓	✓	5
	It was observed that the participants had more difficulties in the writing process than while listening, speaking and reading.	✓	✓	✓	✓	✓	5
	It was observed that the participants were more anxious in the writing process than while listening, speaking and reading.	✓	✓	✓	✓	✓	5
	It was observed that the participants wrote more willingly when writing articles about their favourite games.	✓	✓	✓	✓	✓	5
	It was observed that the feedback given to the participants about their articles increased their desire to write.	✓	✓	✓	✓	✓	5

Note 1: The codes are listed in order of implementation.
Note 2: In this section, the same stages are used for all games.

Table 4 presents the general outlines of the participants' process after the texts and games. Within the scope of the process after the texts and games, activities related to listening, speaking, reading, and writing skills were conducted with the students. During this process, it was observed that the participants utilized all of their language skills.

In addition to the process after the texts and games, the findings obtained by examining the participants' diaries are given in Table 5.

Table 5

Reflections on the Process from the Participants' Diaries Written after the Texts and Games

Process			Reflections from the Participants' Diaries Written after the Games					
Mind and Intelligence Games			Mangala[1] Frequency(f)	Look Look[2] Frequency(f)	Pentago[2] Frequency(f)	Equlibrio[2] Frequency(f)	Qbitz[3] Frequency(f)	Total
Theme, Subthemes and Codes								
Theme: Reflections from the Participants' Diaries Written after the Texts	Participants' views on the game and their personal development	The game was great fun.	P1, P3, P4, P6, P7, P8, P9 f(7)	P1, P2, P3, P4, P5, P7, P8 f(7)	P1, P3, P5, P6, P7, P8, P9, P10 f(8)	P1, P2, P3, P4, P5, P6, P7, P10 f(8)	P1, P5, P7, P6 f(4)	34
		I played the game cheerfully with my friends.	P2, P3, P4, P7, P8, P9, P10 f(7)	P2, P3, P4 P5, f(4)	P3, P5, P7, P8, P9, P10 f(6)	P3, P2, P4, P5 f(4)	P3, P7, P8, P10 f(4)	25
		I loved the game.	P1, P4, P6 P10 f(4)	P1, P4, P8 f(3)	P1, P6, P7, P8, P9, P10 f(6)	P1, P3, P4, P5, P8, P10 f(6)	P1, P5, f(2)	21
		I lost the game.	P7 f(1)	P2, P4 f(2)	P5, P7, P8 f(3)	P7, P2, P4 f(3)	P2, P4, P5 P7 P10 f(5)	14
		I won the game.	P2, P4, P7 f(3)	P2, P4 f(2)	P5, P7, P10 f(3)	P2, P4 f(2)	P4, P5, P10 f(3)	13
		The game was difficult at first.				P10, P7, P6, P5, P3 f(5)	P8, P7, P6, P6, P3, P4 f(6)	11
		I used my time efficiently.	P3, P6, P10 f(3)	P1, P3, P5 f(3)	P1, P5 f(2)	P3 f(1)	P1 f(1)	10
		I learned a new game.	P2, P4, P7, P8, P9, P10 f(6)		P10 f(1)		P1 f(1)	8
		The game was exciting.	P3, P7 f(2)	P1 f(1)				3
	Participants' views on the contribution of the game to their Turkish language skills	The information given about the rules of the game was written correctly in terms of spelling and meaning to a large extent.		P1, P2, P4, P5, P6, P7, P8, P9, P10 f(9)	P3, P4, P5, P6, P7, P8, P9, P10 f(8)	P1, P2, P3, P4, P5, P6, P7, P8, P9 f(9)	P1, P2, P3, P5, P6, P7, P8, P9, P10 f(9)	35
		My writing skills improved with the feedback			P10, P5 f(2)	P3, P4, P5, P2, P8 f(5)		7

	It helped me to learn Turkish.		P6, P8, P7 f(3)	P6, P5, P3, P2 f(4)		7
	It benefited my speaking skills.	P5 f(1)	P5, P10 f(2)	P3, P4 f(2)		5
Participants' views on the contribution of the games to their cognitive skills	The games improved our cognitive skills (memory, attention, intelligence, mathematical skills, visual perception, reasoning, etc.).	P1, P2, P4, P5, P7, P8 f(6)	P1, P5, P6, P7, P8, P9, P10 f(7)	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10 f(10)	P1, P2, P3, P4, P5, P7, P8, P9, P10 f(9)	32

1. The participants only wrote their opinions about the relevant game.
2. The participants only wrote their opinions about the relevant game or wrote the rules of the game.
3. The participants wrote their opinions about the relevant game and wrote the rules of the game.

Table 5 shows the opinions reflected by the participants in their diaries, in which they expressed their opinions after the games and the texts. In this context, the participants stated in their diaries that the games benefited themselves, their Turkish language skills, and their cognitive skills. Participants mostly stated that they found the games fun and loved them, that the games helped them to have a good time with their friends, that they contributed to the development of Turkish language skills in general, and that they were beneficial for the development of their cognitive skills such as memory, attention, and visual perception.

The Results of The Turkish Teaching Process with Mind and Intelligence Games

In this section, the findings obtained as a result of the analysis of the data obtained from the semi-structured interviews, questionnaires, and FLLPS are included. The order in which the findings are discussed is semi-structured interviews, questionnaires, and FLLPS, respectively. Accordingly, the findings related to participants' views on the implementation process are given in Table 6.

Table 6

Findings Related to the Participants' Views on the Implementation Process

Theme, subthemes, and codes*			Participants	Frequency	Total
Theme: Participants' Views on the Implementation Process	Problems faced by participants in another country (Turkey)	There may be problems related to language (speaking, reading comprehension, listening, writing, lack of vocabulary, etc.).	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10	10	20
		There may be problems outside of school (financial needs, accommodation, etc.).	P4, P6, P8, P9	4	
		In the beginning, there may be problems regarding agreement in communication.	P2, P9	2	
		The content of the lessons may be difficult.	P2, P3	2	

		There may be fear of making mistakes in speaking Turkish.	P2, P10	2	
		It contributed to the development of my social skills.	P1, P2, P3, P5, P6, P8, P9	7	
		It contributed to the development of my visual perception skills.	P1, P4, P5, P7, P8	5	
	Benefits of the implementation process in terms of personal development	It contributed to the development of my attention skills.	P1, P8, P9, P10	4	25
		It contributed to the development of my cognitive skills.	P2, P8, P9, P10	4	
		The new games contributed to my learning.	P2, P6, P7	3	
		It contributed to the development of my mathematical skills.	P4	1	
		I realised that I had quick dexterity.	P5	1	
	Benefits of the implementation process in terms of language skills	It contributed to the development of my speaking skills.	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10	10	64
		It contributed to the development of my reading skills.	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10	10	
		It contributed to the development of my listening skills.	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10	10	
		It contributed to the development of my writing skills.	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10	10	
		It contributed to the development of my Turkish language skills.	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10	10	
		It contributed to the development of my vocabulary.	P1, P3, P4, P5, P7, P8, P9	7	
	Suggestions for improving the implementation process	The feedback contributed to the development of skills.	P3, P8, P9, P10	4	7
		It helped me to speak more confidently.	P1, P9, P10	3	
		Longer-term implementations can be made.	P2, P7, P9	3	
		Such implementations can be made for multilingual participants in universities.	P6, P7, P8	3	
		The implementation process can be supported by different activities (such as reading stories and books).	P1	1	

*The flow in the table was arranged according to the interview process and discussed in the context of causality.

Table 6 shows the findings related to the participants' views on the implementation process. The participants stated that the process of teaching Turkish with mind and intelligence games contributed primarily to their language skills as well as to their personal development in different dimensions.

Finally, in order to determine how the implementation process was perceived by the participants, they were asked about their metaphorical perceptions by using the

phrase, "Teaching Turkish with mind and intelligence games is like/similar to…, because…". The participants' opinions in this regard are as follows:

> "Teaching Turkish with mind and intelligence games is like a happy environment because I loved coming to university. You know, when we didn't understand the lesson, we used to say, 'humph!', but now we say, 'we are coming to this event, let's go to the lesson as well'" (P1).
>
> "I would compare the development of our Turkish language skills with mind and intelligence games to our better deciphering of Turkish because I come to play games, it's such fun" (P2).
>
> "I can compare the development of Turkish language skills with mind and intelligence games to being happy because I want to come here. So, the game has been something other than the lessons for us. You did this lesson, and there were friends as well, we spent time with you, something like that. It was fun" (P3).
>
> "I can compare the development of Turkish language skills with mind and intelligence games to a good day because I was never bored, and all the practices were good" (P4).
>
> "I can compare the development of Turkish language skills with mind and intelligence games to being in a group with friends because we spend time together, it is good to socialise and get along by talking; we learn more easily because we talk" (P5).
>
> "I can compare the development of Turkish language skills with mind and intelligence games to going to kindergarten. It teaches both language and literacy in an entertaining way" (P6).
>
> "I would compare the development of Turkish language skills with mind and intelligence games to a child who is a part of my life. So I think, let's say I have a child. First, you communicate with the child by speaking, and you talk about games. Then you talk about mind games. That is, I made it a part of my life" (F7).
>
> "I likened the development of Turkish language skills with mind and intelligence games to the game Equilibrio. This is how we build in this game. In this practice, our language skills also improved like that. We start to learn Turkish from the basics, and we go up to the top" (F8).
>
> "I can compare the development of Turkish language skills with mind and intelligence games to my life song, as whenever I'm in it, I find myself happy and in something I love, because I always sing when I'm happy" (P9).
>
> "I would compare the development of Turkish language skills with mind and intelligence games to something different. There were no such games in Turkmenistan. I played them after I came here, and I had never done it before, so it felt very different" (P10).

Considering the findings regarding the metaphorical perceptions obtained, the participants perceived teaching Turkish with mind and intelligence games as a different process that enabled them to be happy, socialise, have fun, and improve their language skills.

In order to reveal how effective the process of teaching Turkish with mind and intelligence games was in the development of the participants' Turkish language skills, the questionnaire and FLLPS were used. The findings obtained from the questionnaire before and after the implementation are presented in Table 7.

Table 7

Questionnaire Findings of the Participants Before and After the Implementation

Participants	P1		P2		P3		P4		P5		P6		P7		P8		P9		P10	
Process	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Which language	R	L	L	W	L	W	L	L	S	S	S	W	L	L	S	W	L	W	L	W

skill do you have the most difficulty in developing?																					
Which is the easiest language skill for you to develop?	L	S	S	S	S	S	S	W	L	R	L	L	L	W	W	L	S	S	R	L	
What is your level of enjoyment in playing games?	3	3	5	5	1	5	5	3	3	5	5	1	1	4	3	3	5	5	3	3	
To what extent does playing games improve your Turkish language skills?	2	4	1	4	2	5	5	4	3	4	3	2	2	4	4	4	4	5	3	3	
What is your general level of Turkish language skills?	2	3	3	4	3	3	2	3	3	3	3	2	2	3	3	3	2	3	1	4	
At what level can you understand Turkish while listening?	3	3	3	4	2	2	2	3	3	4	4	1	1	3	2	2	2	3	2	4	
At what level can you speak Turkish?	3	4	4	4	2	2	3	3	3	3	4	2	3	3	2	3	3	3	3	4	
At what level can you read Turkish?	2	4	4	4	3	3	3	3	2	4	4	1	2	4	3	4	2	3	3	4	
At what level can you write Turkish?	2	3	3	4	4	4	1	3	2	4	4	2	5	5	5	2	2	3	3	4	
What is your level in terms of Turkish grammar, spelling, and punctuation?	2	3	2	4	3	3	1	2	3	3	3	2	4	3	1	3	2	3	2	3	
Total score	19	27	25	33	20	27	22	24	22	30	30	13	20	29	23	24	22	28	20	29	

Explanation of abbreviations and figures in table: L: Listening, S: Speaking, R: Reading, W: Writing
1: I am not competent, 2: I am somewhat competent, 3: I am moderately competent, 4: I am competent, 5: I am very competent

Table 7 shows the questionnaire findings of the participants. The language skills that the participants had the most difficulty in developing and the skills they developed the most easily differed according to the results of the preliminary and final questionnaires. Furthermore, based on the final questionnaire results of the participants, they generally thought that playing games improved their Turkish language skills.

The implementation made regarding teaching Turkish with mind and intelligence games made positive contributions to the participants' language skills. In addition, the Wilcoxon signed-ranks test was used in order to reveal the statistical results between the pretest and posttest implementation of the FLLPS. The findings obtained in this regard are given in Table 8.

Table 8

Results of Students' FLLPS Scores Within the Scope of the Pretest and Posttest According to Wilcoxon Signed-Ranks Test

FLLPS Total Pretest-Posttest	*n*	Mean rank	Rank sum	*z*	*p*
Negative rank	1	1.00	1.00	2.703	.007
Positive rank	9	6.00	54.00		
Equal	0				
General Learning Practices (GLP) Subdimension Pretest-Posttest	*n*	Mean rank	Rank sum	*z*	*p*
Negative rank	1	1	1	2.710	.007
Positive rank	9	6	54		
Equal	0				
Speaking Learning Practices (SLP) Subdimension Pretest-Posttest	*n*	Mean rank	Rank sum	*z*	*p*
Negative rank	2	9.25	18.50	.919	.358
Positive rank	8	4.56	36.50		
Equal	0				
Reading Learning Practices (RLP) Subdimension Pretest-Posttest	*n*	Mean rank	Rank sum	*z*	*p*
Negative rank	2	3.75	7.50	1.103	.270
Positive rank	5	4.10	20.50		
Equal	3				
Writing Learning Practices (WLP) Subdimension Pretest-Posttest	*n*	Mean rank	Rank sum	*z*	*p*
Negative rank	1	1.00	1.00	2.552	.011
Positive rank	8	5.50	44.00		
Equal	1				

Grammar Learning Practices (GrLP)					
Subdimension Pretest-Posttest	*n*	Mean rank	Rank sum	*z*	*p*
Negative rank	0	.00	.00	2.825	.005
Positive rank	10	5.50	55.00		
Equal	0				
Listening Learning Practices (LLP)					
Subdimension Pretest-Posttest	*n*	Mean rank	Rank sum	*z*	*p*
Negative rank	1	3.00	3.00	1.930	.054
Positive rank	6	4.17	25.00		
Equal	3				

*Based on Negative Ranks p<.05

When Table 8 is taken into consideration, there is a significant difference (z=-2.703*, p<.05) between the scores obtained by the students from the FLLPS in the pretest and posttest. Considering the mean ranks and rank sums of the difference scores, this observed difference is in favour of the posttest. In addition, when the scores obtained from the subdimensions of the relevant scale are examined within the scope of the pretest and posttest, the subdimensions with significant differences are GLP (z=-2.710*, p<.05); WLP (z=-2.552*, p<.05) and GrLP (z=-2.825*, p<.05), while the subdimensions in which there is no significant difference are SLP (z=-.919, p>.05), RLP (z=-1.103, p>.05) and LLP (z=-1.930, p>.05). Accordingly, the students generally improved in their language skills and they improved more specifically in general, writing and grammar learning practices.

Ethical Procedures

In this study, attention was paid to scientific ethical rules. In this regard, ethics committee approval dated 14.07.2020 and numbered 12 was obtained from the Social and Human Sciences Ethics Committee of Kafkas University.

Discussion, Conclusion and Implications

In this study, the effect of mind and intelligence games on the development of multilingual preservice classroom teachers' Turkish language skills was examined. An interdisciplinary approach (Jones, 2010), which primarily supports more than one discipline, enriches the learning process and is a challenging but important technique in modern curricula, was adopted. Based on this approach, the Turkish teaching process and the game process were combined. In fact, playing games is one of the oldest and most common forms of learning, and is more than an educational tool (Coleman, 1976). Accordingly, mind and intelligence game activities were conducted in the text-teaching process. Before the texts, activities aimed at listening and speaking skills, such as examining the game images and materials, doing exercises on keywords related to the games, and guessing how the game is played, were carried out. During the texts, exercises aimed at reading skills were carried out on informative texts about the games, and the participants were allowed to play the games individually or in groups. In the last process, the participants were asked to write about the implementation process, and

activities were carried out to improve their writing skills. There is a relationship between the basic language skills, namely listening, speaking, reading, and writing skills, and these skills are developed by supporting each other (Garcia, 2009; Maden, 2013). In this study, activities aimed at improving the participants' language skills were considered together. Along with their language skills (listening, speaking, reading, and writing), the participants also used their intellectual skills (problem-solving, visual attention, reasoning, etc.) by playing mind and intelligence games. People label objects by using language, and in this case, the mind produces language, and through play, the mind navigates between the item and what is thought about (Huizinga, 2006). Moreover, the play process includes the affective and psychomotor processes. Therefore, the participants underwent intense cognitive, affective, and psychomotor experiences based on language and play. Silberman (2016) supports this idea and states that learning should occur by doing and experimenting and that learning in this way paves the way for the development of skills. Experiential learning can come to mind as the source of this judgement. As a justification for this, it can be argued that the participants underwent an active and passive experience (Dewey, 2004) and learned through their experiences (Dewey, 2013). At this point, Kolb (2015) states that experiential learning is process-oriented, is based on experience, includes a holistic process of adaptation to the world, involves transactions between the person and his/her environment, and is a knowledge-creation process. There are similarities between the characteristics of experiential learning expressed by Kolb (2015) and the implementation that was made. The results to be obtained from this research concerning the development of skills primarily emerge on the basis of experiential learning.

When the participants' views reflected in their diaries regarding the implementation processes are taken into consideration, the outputs of experiential learning are observed. Accordingly, the participants indicated that the mind and intelligence games benefited them, their Turkish language skills (listening, speaking, reading, and writing), their cognitive skills (memory, attention, perception, etc.), and their affective skills (socialising, feeling happy, having fun, etc.). This contribution can be a result of the fact that playing games requires the use of both linguistic and intellectual skills together (Güneş, 2015). These views expressed by the participants can be considered as a positive result of the intense experiences in the program that was implemented. In support of this result, it was observed that the participants also had positive metaphorical perceptions about the development of their Turkish language skills through mind and intelligence games. Accordingly, the participants stated that they perceived the implementation related to developing Turkish language skills with mind and intelligence games as a different process that enabled them to socialise, have fun and improve their Turkish language skills. This different process can be associated with the use of educational games within the scope of active learning recommended by today's educational approaches (Güneş, 2015; Kara, 2010). In fact, while actively learning, the student is determined, cheerful, willing, empathetic, collaborative, and a reconstructor of knowledge (O'Neill, 2016). Kalfa (2014) stated that educational games that enable learning while having fun should be used in teaching Turkish to foreigners and reinforcing what is taught. Similarly, Kara (2010) stated that the use of games in teaching languages to foreigners improves a number of skills, from language skills to social skills, and enables active learning. Furthermore, when the results obtained from

the questionnaires are examined, they support both the interview and metaphor results and the related literature (Kalfa, 2014; Kara, 2010; O'Neill, 2016). Based on the scores of most of the participants in the preliminary and final closed-ended questionnaire questions, there is a positive difference in favour of the final questionnaire. Accordingly, most of the participants stated that playing mind and intelligence games had positive effects on the development of their Turkish language skills. In addition, the participants also stated that language skills should be developed through a learning process supported by materials and accompanied by an instructor, in which all language skills are used. In fact, these views expressed by the participants are also consistent with the basic principles of teaching Turkish to foreigners (Barın, 2004). For example, within the scope of the research, going from the concrete to the abstract, dealing with the four basic language skills together, enabling students to learn actively, and the fact that this implementation is practical can be considered in the context of the basic principles (Barın, 2004). In this direction, Lüle Mert (2014) stated the necessity of practical activities in Turkish teaching. Based on this point of view, it can be said that in line with the context in which the participants expressed themselves, the process of improving the Turkish language skills of multilingual students through mind and intelligence games had positive effects on the participants' language skills. In order to examine this statement from a quantitative perspective, it was observed that there was a significant difference in favour of the posttest between the total scores obtained by the participants in the pretest and posttest from the FLLPS, as well as the total scores they obtained from the GLP, WLP, and GrLP subdimensions. Accordingly, the students generally made progress in their Turkish language skills and that within this scope, they developed specifically in general learning practices and the subjects of writing and grammar. Based on all these results, it was concluded that the mind and intelligence games had a positive effect on the development of multilingual students' language skills.

It may be possible to say that the positive results obtained from the research are not only consistent with each other but are also compatible with the outcomes of experiential learning. In a process where there are numerous stimuli, cultural interaction is also experienced intensely. This statement can basically be grounded on Huizinga's (2006) idea that culture is born in the form of play. In fact, individuals who learn two or more languages learn not only those languages but also the cultures belonging to those languages (Paradis et al., 2011). One of the general principles in teaching Turkish to foreigners is to teach the culture together with the language (Barın, 2004). Since language skills are learned by experience (Çelebi, 2006), the implementation process also includes cultural interaction in the context of experiential learning. In this regard, Gün and Şimsek (2020) state that teaching Turkish as a foreign language is not only language teaching but also has international dimensions, and one of these dimensions is culture. Therefore, the implementation that was made had cognitive, affective, psychomotor, and socio-cultural dimensions. In support of this, the fact that the multilingual students learned Turkish games in the process, gave examples of games similar to these games from their own culture, communicated in Turkish with the instructors during the game process, and provided explanations from their own culture within the context of the implementation process, can be considered within the socio-cultural dimensions of the implementation process. Therefore, in this implementation,

the multilingual students' language skills developed on a cognitive, affective, psychomotor, and socio-cultural structure.

In this study, the effect of mind and intelligence games on the development of multilingual preservice classroom teachers' language skills was examined. The process of developing multilingual preservice classroom teachers' language skills was designed by considering an interdisciplinary context. Accordingly, basically, the Turkish teaching process and the game-playing process, and specifically, the Turkish language skills (listening, speaking, reading, and writing) and the process of playing mind and intelligence games, were combined. A rich and entertaining learning environment in cognitive, affective, and psychomotor terms was created, and the participants actively participated in the learning process. Games are one of the most effective ways of active learning. According to the results obtained from the data collection tools, at the end of this game process, the participants' Turkish language skills (listening, speaking, reading, and writing), cognitive skills (memory, attention, perception, etc.), and affective skills (socialising, feeling happy, having fun, etc.) improved. It was also observed that this development process took place on the basis of cultural interaction, while this development process (linguistic, cognitive, affective, and cultural) took place in the context of experiential learning. The fact that the multilingual preservice classroom teachers were in interaction with concrete materials by doing and experiencing improved their Turkish language skills. This process designed with mind and intelligence games can also be considered as a step towards a better understanding of the relationship between language, mind, and culture. In addition, this research will contribute to the literature in terms of experimentally addressing the subjects of mind and intelligence games, multilingual students, and the development of language skills.

In this research, the development of Turkish language skills has been taken into account, and the process of developing language skills in multilingual students through mind and intelligence games has been examined from different perspectives. An attempt has been made to investigate the reasons for the emerging development of the key elements. However, in order to better understand and analyse these results, the limitations of the research should also be emphasised. Clarifying these limitations can lead to better recommendations for future studies. Accordingly, the lack of a control group in the study can be regarded as one of the main limitations. First of all, the main reason for working with a single group in this study is that the problems experienced by the multilingual students regarding their language skills were noticed by the researchers, and that these problems were emphasised. For this reason, most of the multilingual students in the relevant department were included in the research process, and the research was conducted with a single group. In addition, there were insufficient multilingual students to form a control group in the relevant department and under the same conditions. However, in order to reduce this limitation to some extent, different data collection tools were utilized. These limitations may contribute to strengthening future studies in the fields of games and language skills. Furthermore, in future studies in the relevant field, scientific research can be conducted on the development of language skills using different games and research methods with different multilingual student groups. In addition, mind and intelligence games can also be used to improve the basic skills (linguistic, cognitive, social, etc.) of students (typically developing, special needs, multilingual, foreign national, immigrant, etc.) studying at all levels of

education, especially preschool and primary school, and different scientific studies can also be conducted for this purpose.

Statement of Responsibility

The authors contributed together to literature review, conception and design, acquisition of data, analysis, and interpretation of data.

Conflicts of Interest

Authors declare that there is no conflict of interest.

Author Bios:

Fatma Gül Uzuner is an assistant professor in the Faculty of Education at Kafkas University in Turkey. She completed her PhD in Primary Education at *Karadeniz Teknik University* in Turkey. Her research interests include game-based learning, orienteering and mathematics teaching.

Meral Gözüküçük is an assistant professor in the Faculty of Education at Manisa Celal Bayar University in Turkey. She completed her PhD in Primary Education at *Pamukkale University* in Turkey. Her research interests include literacy, bilingual education, primary reading and writing, and Turkish language education.

References

Alver, M. (2019). Türkçenin yabancı dil olarak öğretilmesinde esas alınan ilkeler ile kullanılan yöntem ve teknikler [Principles and methods and techniques used in teaching Turkish as a foreign language]. In İ. Erdem, B. Doğan & H. Altunkaya (Eds.), *Türkçenin yabancı dil olarak retimed [Teaching Turkish as a foreign language]* (pp. 13-42). Pegem Akademi.

Aşuluk, Y. (2020). Zekâ oyunlarının ilkokul 3. sınıf öğrencilerinin Türkçe dersinde okuduğunu anlama becerisine etkisi [The effect of mind games on the reading comprehension skill of primary education third grade students in Turkish course] [Unpublished master's thesis]. Hacettepe University.

Avedon, E. M., & Sutton-Smith, B. (1971). *The study of game*. John Wiley & Sons, Inc.

Baker, C. (2011). *Foundations of bilingual education and bilingualism*. Multilingual Matters.

Barın, E. (2004). Yabancılara Türkçe öğretiminde ilkeler. *Hacettepe Üniversitesi Türkiyat Araştırmaları (HÜTAD)*, *1*, 19-30. Retrieved from https://dergipark.org.tr/en/pub/turkiyat/issue/16660/329608

Biçer, N. (2017). Yabancılara Türkçe öğretimi alanında yayınlanan makaleler üzerine bir analiz çalışması [An analysis study on the published articles relating to the field of teaching Turkish to foreigners]. *Pamukkale Üniversitesi Sosyal Bilimler Enstitüsü Dergisi 27*, 236-247. Retrieved from https://dergipark.org.tr/en/pub/pausbed/issue/34758/384478

Birova, I. L. (2013). Game as a main strategy in language education. *American Journal of Educational Research*, *1*(1), 7-11. http://doi.org/10.12691/education-1-1-2

Butler, Y. G. (2014). Bilingualism/multilingualism and second-language acquisition. In T. K. Bhatia & W. C. Ritchie (Eds.), *The handbook of bilingualism and multilingualism*. Wiley-Blackwell.

Cambridge Dictionary. (2021). Retrieved from https://dictionary.cambridge.org/tr/s%C3%B6zl%C3%BCk/ingilizce/mind

Çelebi, M. D. (2006). Türkiye'de anadili eğitimi ve yabancı dil öğretimi [Education of mother tongue and teaching foreign language in Turkey]. *Erciyes Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *1*(21), 285-307. Retrieved from https://dergipark.org.tr/en/pub/erusosbilder/issue/23754/253119

Cohen, D. (1993). *The development of play*. Routledge.

Coleman, J. S. (1976). Learning through games. In J. S. Bruner, A. Jolly & K. Sylva (Eds.), *Play: Its role in development and evolution*, (pp. 460-463). Penguin Books.

Creswell, J. W. (2013). *Qualitative inquiry & research design: Choosing among five approaches (3rd ed.)*. Sage Publications.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative and mixed methods approaches (4th ed.)*. Sage Publications.

Creswell, J. W., & Plano-Clark, V. L. (2011). *Designing and conducting mixed methods research (2nd edition)*. Sage Publications.

Datta, L. (1990). *Case study evaluations.* U.S. General Accounting Office.

Devecioğlu, Y., & Karadağ, Z. (2014). Amaç, beklenti ve öneriler bağlamında zekâ oyunları dersinin değerlendirilmesi [Evaluation of mind puzzle course at the context of goals, expectations and recommendations]. *Bayburt Eğitim Fakültesi Dergisi*, *9*(1), 41-61. Retrieved from https://dergipark.org.tr/en/pub/befdergi/issue/23139/247172

Dewey, J. (2004). *Demokrasi ve eğitim* [Democracy and education]. (Transl. T. Göbekçin). Yeryüzü Publisher.

Dewey, J. (2013). *Deneyim ve eğitim* [Experience and education]. (Transl. S. Akıllı). ODTÜ Publisher.

Fink, A., & Kosecoff, J. (1985). *How to conduct surveys: A step-by-step guide.* Sage Publications.

Garcia, O. (2009). *Bilingual education in the 21st century: A global perspective*. Wiley-Blackwell.

Gass, S. M., Behney, J., & Plonsky, L. (2013). *Second language acquisition: An introductory course.* Routledge Taylor & Francis Group.

Gün, M., & Şimşek, R. (2020). Yabancı dil olarak Türkçe öğretiminde sosyo-kültürel yansımalar [Socio-cultural reflections in teaching Turkish as a foreign language]. *Turkish Journal of Primary Education*, *5*(1), 46-58. Retrieved from https://dergipark.org.tr/en/pub/tujped/issue/55035/738428

Güneş, D. (2021). Sınıf öğretmenlerinin akıl ve zekâ oyunlarının ilkokulda kullanımına yönelik değerlendirmeleri [Assessments of classroom teachers on the use of mind and intelligence games in primary school] [Unpublished master's thesis]. Balıkesir University.

Güneş, F. (2015). Oyunla öğrenme yaklaşımı [Game-based learning approach]. *Turkish Studies - International Periodical for The Languages, Literature and History of Turkish or Turkic, 10*(11), 773-786. Retrieved from http://dx.doi.org/10.7827/TurkishStudies.8499

Gürsoy, A., & Arslan, M. (2011). Eğitsel oyunlar ve etkinliklerle yabancılara Türkçe öğretim yöntemi. *In 1st International Conference on Foreign Language Teaching and Applied Linguistics, Mayıs* (pp. 5-7), Sarajevo.

Huizinga, J. (2006). *Homo Ludens: Oyunun toplumsal işlevi üzerine bir deneme* [Homo ludens: Essai sur la fonction sociale du jeu] (Transl. M. A. Kılıçbay). Ayrıntı Publishing.

Hummel, K. M. (2014). *Introducing second language acquisition perspectives and practices.* Wiley-Blackwell.

Jones, C. (2010). Interdisciplinary approach-advantages, disadvantages, and the future benefits of interdisciplinary studies. *Essai, 7*(1). Retrieved from http://dc.cod.edu/essai/vol7/iss1/26

Kalfa, M. (2014). Yabancılara Türkçe öğretiminde temel düzeydeki öğrencilerin eğitsel oyunlarla yazma becerilerinin geliştirilmesi [Developing the writing skills of basic level students through educative games in teaching Turkish to foreign learners]. *Hacettepe Üniversitesi Türkiyat Araştırmaları Dergisi*, *20*, 85-102.

Kara, M. (2010). Oyunlarla yabancılara Türkçe öğretimi [Teaching Turkish to foreigners through games]. *Türklük Bilimi Araştırmaları*, *27*, 407-421. Retrieved from https://dergipark.org.tr/en/pub/tubar/issue/16968/177241

Kolb, D. (2015). *Experiential learning: Experience as the source of learning and development*. Pearson Education, Inc.

Lanza, E. (2010). Selecting individuals, groups, and sites. L. Wei & M. G. Moyer, (Eds.), In *Research methods in bilingualism and multilingualism*. Blackwell Publishing.

Liberali, F. (2013). Students-teachers and teacher-educators experience new roles in pre-service bilingual teacher education in Brazil. In C. Abello-Contesse, P. M. Chandler, M. D. Lopez-Jimenez & R. Chacon-Beltran (Eds.), *Bilingual and multilingual education in the 21st century building on experience*. Multilingual Matters.

Lüle Mert, E. (2014). Türkçenin eğitimi ve öğretiminde dört temel dil becerisinin geliştirilmesi sürecinde kullanılabilecek etkinlik örnekleri [The activity examples that can be used in the development process of basic language skills in education and teaching of Turkish]. *Ana Dili Eğitimi Dergisi, 2*(1), 23-48. Retrieved from https://doi.org/10.16916/aded.47575

Maden, S. (2013). Instructional work and tactics in active learning used on basic language arts. *Journal of Mother Tongue Education, 1*(2), 20-35.

Marian, V. (2013). Bilingual research methods. In J. Altarriba & R. R. Heredia (Eds.), *An introduction to bilingualism principles and processes*. Psychology Press.

McMillan, J. H., & Schumacher, S. (2014). *Research in education: Evidence-Based inquiry (7th ed.)*. Pearson.

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation.* John Wiley & Sons.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook.* Sage Publications.

National Association for the Education of Young Children (NAEYC). (2021). 12 Principles of child development and learning. Retrieved from https://www..org/resources/topics/12-principles-of-child-development

O'Neill, H. (2016). *Başarının yol haritası ile aktif öğrenme (Etkili Öğrenci)* [Active learning with the roadmap to success (Effective Student)]. Siyah Beyaz Publishing.

Özdevecioğlu, B. & Hark Söylemez, N. (2021). Akıl ve zekâ oyunları ile ilgili olarak yapılan lisansüstü çalışmaların değerlendirilmesi [Evaluation of Graduate Studies on Mind and Intelligence Games]. *Iğdır Üniversitesi Sosyal Bilimler Dergisi, 28*, 17-53.

Paradis, J., Genesee, F., & Crago, M. B. (2011). *Dual language development & disorders: A handbook on bilingualism & second language learning*. Paul H. Brookes Publishing.

Patton, M. Q. (2002). *Qualitative evaluation & research methods (3rd ed.).* Sage Publications.

Roberts, J. M., & Sutton-Smith, B. (1962). Child training and game involvement. *Ethnology, 1*(2), 166-185. Retrieved from https://www.jstor.org/stable/3772873

Robson, C. (2011). *Real world research.* John Wiley & Sons Limited.

Salkind, N. (2011). *Statistics for people who (think they) hate statistics (4th ed.)*. Sage Publications.

Scarlett, W., Naudeau, S., Salonius-Pasternak, D., & Ponte, I. (2005). *Children's play*. Sage Publications.

Şen, M. (2020). Akıl ve zeka oyunlarının 60-72 aylık çocuklarda erken okuryazarlık becerilerine etkisinin incelenmesi [Investigation of the impact of the mind and intelligence games on the early literacy skills of 60-72 months of children] [Unpublished master's thesis]. Üsküdar University, İstanbul.

Sheridan, M. D. (2011). *Play in early childhood: From birth to six years*. Taylor & Francis.

Silberman, M. (2016). *Aktif öğretim: Sınıflarda öğrenmeyi harekete geçirecek sekiz adım ve 32 strateji* [Teaching Actively: Eight steps and 32 strategies to spark learning in any classroom] (Transl. Ed. N. Kalaycı). Pegem Academy.

Smith, P., & Jones, O. J. (1997). *The philosophy of mind: An introduction*. Cambridge University Press.

The Ministry of National Education (MNE). (2013). Ortaokul ve imam hatip ortaokulu zekâ oyunları dersi (5, 6, 7 ve 8. sınıflar) öğretim programı [Middle school and imam hatip secondary school intelligence games course (5, 6, 7 and 8th grades) educational program].

Turkish Intelligence Foundation. (2021). Retrieved from https://www.tzv.org.tr/#/zekâ/zekâ_nedir

Wei, L. (2014). Conceptual and methodological issues in bilingualism and multilingualism research. In T. K. Bhatia & W. C. Ritchie (Eds.), *The handbook of bilingualism and multilingualism.* Blackwell Publishing.

Winnicott, D. W. (2017). *Oyun ve gerçeklik* [Playing and reality]. (Transl. T. Birkan,). Metis Publications.

Yeşil, R. (2018). Yabancı dil olarak Türkçeyi öğrenme uygulamaları ölçeğinin geçerlik ve güvenirlik çalışması. *Electronic Turkish Studies, 13*(19), 1969-1987. Retrieved from http://dx.doi.org/10.7827/TurkishStudies.13892

Journal of Theoretical Educational Science, 16(3), 700-726, July 2023
Kuramsal Eğitimbilim Dergisi, 16(3), 700-726, Temmuz 2023
[Online]: http://dergipark.org.tr/akukeg
DOI number: http://doi.org/10.30831/akukeg.1225513

A Bibliometric Analysis of Research on Self-Regulated Learning: From the Beginning to 2021

Öz-düzenlemeli Öğrenme Üzerine Yapılan Araştırmaların Bibliyometrik Analizi: Başlangıçtan 2021'e

Rahime ÇOBANOĞLU* **Serap BÜYÜKKIDIK****
Gülfem D. YURTTAŞ KUMLU***

Received: 28 December 2022 **Review Article** **Accepted:** 29 June 2023

ABSTRACT: The present study explores the self-regulated learning (SRL) research published in English or Turkish language journals included in the Web of Science database from the beginning to 2021 via bibliometric analysis. The 2197 articles that met the eligibility criteria were included in the study. The results reveal that the research on SRL has been carried out mostly by scholars from the USA and has gained increased attention since the 2000s. The three most influential scholars of self-regulated research are Chia-Wen Tsai, Philip H. Winne, and Roger Azevedo; however, the two top documents by local citations belong to Barry J. Zimmerman (2008) and Paul R. Pintrich (2004) in the study. The analyzed studies cited the Journal of Educational Psychology and Contemporary Educational Psychology most. The results reveal that motivation, metacognition, self-efficacy, and learning strategies are the keywords that most frequently occur and co-occur in the analyzed studies along with SRL. The trend topics of SRL research have been learning analytics, flipped classrooms, and MOOCs since 2018.

Keywords: Bibliometric analysis, learning, self-regulated learning, Web of Science database.

ÖZ: Bu çalışma, başlangıçtan 2021 yılına kadar Web of Science veri tabanında yer alan İngilizce veya Türkçe dergilerde yayınlanan öz-düzenlemeli öğrenme araştırmalarını bibliyometrik analiz yoluyla incelemektedir. Uygunluk kriterlerini karşılayan 2197 makale çalışmaya dahil edilmiştir. Sonuçlar, araştırmaların çoğunlukla ABD'li akademisyenler tarafından yürütüldüğünü ve öz-düzenlemeli öğrenmenin 2000'li yıllardan bu yana eğitim araştırmalarında artan bir ilgi gördüğünü ortaya koymaktadır. Öz-düzenlemeli öğrenme araştırmalarının en etkili üç akademisyeni Chia-Wen Tsai, Philip H. Winne ve Roger Azevedo olarak belirlenirken, yerel atıflara göre en etkili ilk iki doküman Barry J. Zimmerman (2008) ve Paul R. Pintrich'e (2004) aittir. İncelenen çalışmalar en çok Journal of Educational Psychology ve Contemporary Educational Psychology dergilerine atıfta bulunmuştur. Ayrıca, sonuçlar incelenen çalışmalarda öz-düzenlemeli öğrenme ile birlikte en sık geçen ve birlikte kullanılan anahtar kelimelerin motivasyon, üstbiliş, öz-yeterlik ve öğrenme stratejileri olduğunu göstermektedir. 2018'den bu yana SRL araştırmalarının trend konuları öğrenme analitiği, ters yüz edilmiş sınıflar ve MOOC'lar olmuştur.

Anahtar kelimeler: Bibliyometrik analiz, öğrenme, öz-düzenlemeli öğrenme, Web of Science veri tabanı.

* *Corresponding Author*: Dr., Sinop University, Sinop, Türkiye, crahime@gmail.com, https://orcid.org/0000-0003-4662-8920
** Dr., Sinop University, Sinop, Türkiye, sbuyukkidik@gmail.com, https://orcid.org/0000-0003-4335-2949
*** Dr., Sinop University, Sinop, Türkiye, gdyurttas@gmail.com, https://orcid.org/0000-0003-4741-2654

Citation Information
Cobanoğlu, R., Büyükkıdık, S., & Yurttaş Kumlu G. D. (2023). A bibliometric analysis of research on self-regulated learning: From the beginning to 2021. *Kuramsal Eğitimbilim Dergisi [Journal of Theoretical Educational Science], 16*(3), 700-726.

ISSN: 1308-1659

Self-regulated learning (SRL) is a crucial skill for the 21st century, an era that prioritizes learning how to learn rather than the direct transmission of information (Saavedra & Opfer, 2012). Due to our need for lifelong learning, it is critical that individuals are empowered to become self-regulated learners in schools (Zimmerman, 2002). The promises of SRL for effective academic learning have paved the way for developing interventions that basically aim to provide individuals with the required information, motivation, and skills for SRL (Winne, 1995). We agree that making a shift from other-regulated learning to SRL should be an educational goal for all individuals (Paris & Newman, 1990) as SRL, explaining academic achievement differences among learners, can turn into an effective means for improving learner performance (Pintrich & De Groot, 1990; Schunk, 2005).

The current study examines the intellectual structure within the broad field of SRL from its inception to 2021 (December 31) through bibliometric analysis to reveal the evolution of the construct. There exist many review studies on SRL, some of which are very recent (e.g., Anthonysamy et al., 2020; Araka et al., 2020; Blackmore et al., 2021; Dignath & Veenman, 2021; Hooshyar et al., 2020; Lim & Yeo, 2021; Min & Nasir, 2020; Theobald, 2021). To our current knowledge, Zhang et al. (2020) carried out a bibliometric study on SRL; however, its scope is limited to game-based self-regulated learning. Saepulmilah and Azhari (2022) published a bibliometric study with a focus on SRL; nonetheless, this study covers the data between 2017 and 2021. Despite years of research on SRL, the field is considered weak regarding bibliometric analysis. Such analyses are essential for capturing the academic view of the literature on a research area (Mejia & Kajikawa, 2017) and demonstrating the scientific productivity and the characteristics of scientific growth in a given field (Andres, 2009). In light of this, the current study applied a bibliometric analysis to uncover various aspects of SRL research. Specifically, this study aims to reveal (a) the productivity and citations over the years, (b) the most influential countries, collaborations, scholars, articles, and journals in SRL research, (c) the keywords that frequently occur in the SRL publications and the words in their references, and (d) the co-occurring keywords and the important themes in the SRL literature. The findings drawn from this bibliometric analysis are expected to demonstrate the trends, identify new developments in SRL research, and provide significant implications for future research in SRL.

Definition of SRL

Zimmerman (1990) defines SRL by highlighting three fundamental features including learning strategies, self-oriented feedback, and independent motivation. According to Zimmerman, self-regulated learners apply appropriate learning strategies to accomplish the desired outcome considering feedback about their learning performance. Pintrich (1995) similarly draws attention to an individual's active and goal-directed control of behavior, motivation and affect, and cognition in SRL. As Torrano Montalvo and González Torres (2004) define, SRL is a combination of an individual's skill and will to optimize his or her performance by controlling and adjusting the learning process.

The literature commonly proposes that the SRL process occurs in three phases, including the "preparatory phase," "actual performance phase," and the "appraisal phase" (Puustinen & Pulkkinen, 2001). Broadly, in the preparatory phase of SRL,

learners examine the tasks, plan, and set targets. In the phase of performance, they use strategies and monitor their activities. In the appraisal phase, learners evaluate their performance and their outcomes.

Research on SRL

SRL has been an important strand of research for years, especially in education since 1980 (Schunk & Greene, 2018). Paris and Paris (2001) noted that Educational Psychologist devoted special issues to SRL, and more than 30 articles related to SRL were published in this single journal during the period between 1990 and the year of their study. Winne (2005), using PsycINFO, found 463 hits with the phrase "self-regulated learning" searched in all text, while there were 103 publications in 1995 on SRL and only one article in 1976 (i.e., Mlott et al., 1976). According to Panadero (2017), the emergence of meta-analysis studies, new models, and a new handbook on SRL after 2001 are important hallmarks in the development of the field.

Today, a great deal of scientific publications has accumulated in the field of SRL. Boekaerts (1999) argues that the three schools of thought, namely "metacognition and regulation styles," "research on learning styles," and "theories of self and goal-directed behaviors," have greatly influenced the research on SRL. Schunk and Greene (2018) define three paradigms, which have predominantly influenced the SRL research since the 1980s, including the research on the relation of SRL to academic outcomes, intervention studies to teach SRL and their effect on student outcomes, and the more dynamic studies on the operation of SRL processes and changes in outcomes in a cyclical fashion. The studies on SRL are generally diverse regarding the approaches, methods, and subject areas. The common measurement tools of the SRL studies involve self-report inventories, think-aloud protocols, unstructured interviews, and traces of cognitive events (Winne, 2010). The development of the "Motivated Strategies for Learning Questionnaire (MSLQ)" by Pintrich et al. (1993), a valid and reliable tool that addresses individuals' motivational orientations and their use of learning strategies, has especially played a great role in the proliferation of research on SRL (Schunk, 2005).

The review studies have also occupied an important place in SRL research. The recent review studies on SRL research have especially delved into different types of technology-enhanced learning environments, including online learning (e.g., Broadbent & Poon, 2015), e-learning (e.g., Garcia et al., 2018), massive open online courses (MOOCs) (e.g., Alonso-Mencía et al., 2020; Wong et al., 2019), blended learning (e.g., Anthonysamy et al., 2020), flipped learning (e.g., Rasheed et al., 2020), mobile learning (e.g., Palalas & Wark, 2020), and learning analytics dashboards (Matcha et al., 2019). Moreover, the review studies by van Houten-Schat et al. (2018) and Cho et al. (2017) explore the SRL in the context of medical education. While the meta-analytic review of Panadero et al. (2017) examines the relationship between self-assessment and SRL, Ergen and Kanadli (2017) review the link between SRL and academic achievement.

These review studies, reduced to specific aspects of SRL, are important. Yet more comprehensive reviews are required to understand the general status of the SRL research and propose future directions. The current study takes advantage of bibliometric analysis to expand the scope of the review to present an inclusive overview of this broad field of study. Presenting a holistic view of a research area is vital when

the number of publications is great, and its boundaries are complicated (Mejia & Kajikawa, 2017), as it is in SRL research.

Method

This study is a bibliometric analysis of research on SRL. In a broader sense, a bibliometric study provides a bibliographic overview of scientific productions within an identified subject area via quantitative analysis (Ellegaard & Wallin, 2015). Donthu et al. (2021) state that bibliometric studies, used especially when the dataset is too large and the review scope is broad, can greatly advance the field by showing the less developed areas in the literature and triggering novel ideas for future studies.

Search Procedure

In this study, we used the Web of Science (WOS) database that hosts a broad collection of widely known journals in social sciences to reach scientific publications on SRL. As suggested by Linnenluecke et al. (2020), an initial review exercise was undertaken by the three researchers to determine the scope and search terms. Considering previous review studies (e.g., Broadbent & Poon, 2015; Gambo & Shakir, 2021; Lee et al., 2019; Moos & Ringdal, 2012; Wong et al., 2019), the following terms were searched in the abstract: “self-regulated learning” or “SRL” or "self-regulat* learning” or “self-regulat* learn*,” or “self-regulat* learning strateg*.” The search, performed on January 19, 2022, involved all years except 2022 and was confined to articles as the document type.

Selection of the Publications

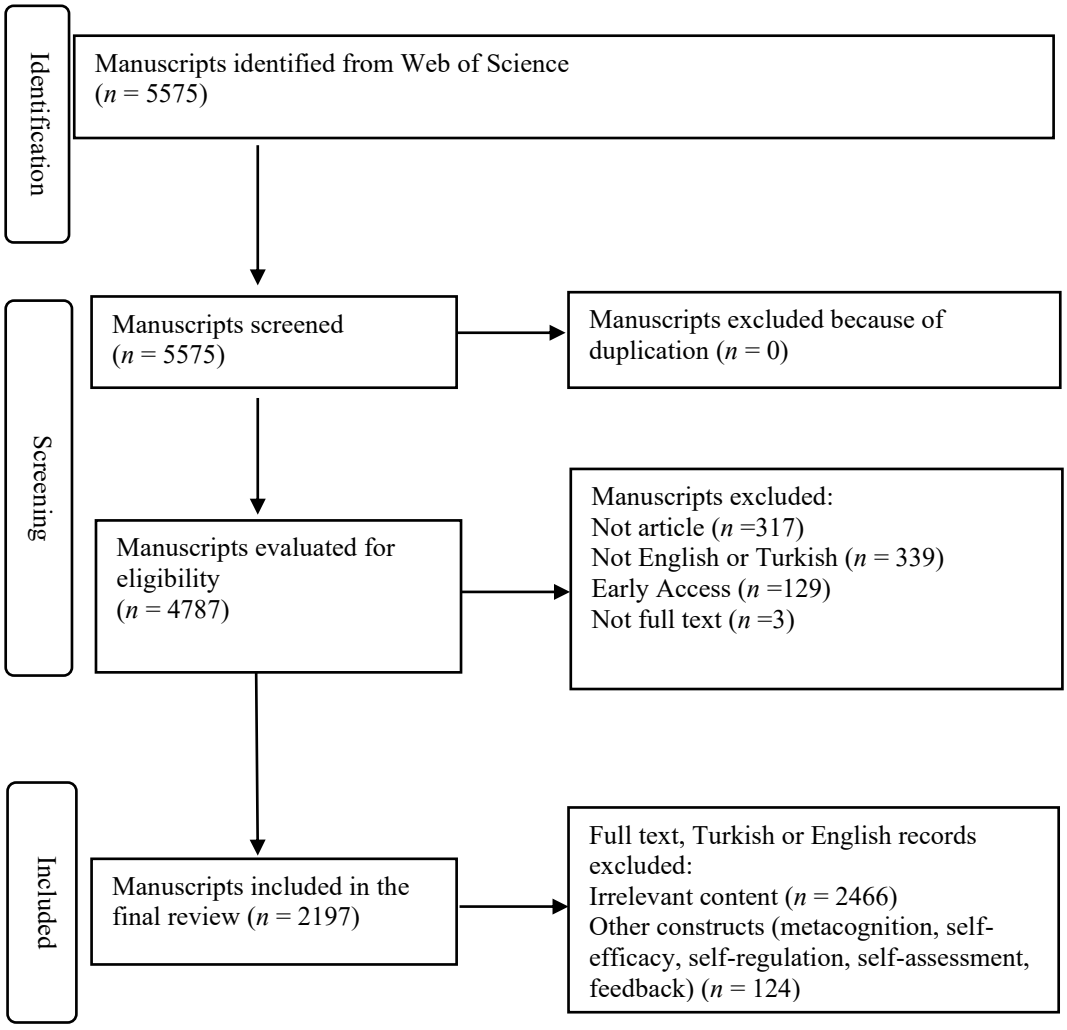
The search resulted in 5575 publications, while 2197 articles were included in the analysis (see Figure 1). The early access articles that did not provide a publication year and the publications for which the document type was defined as a book chapter or proceeding rather than an article were not involved in the data set. As the title and the abstract were not always helpful in making a judgment if a publication addressed SRL, the researchers needed to examine the full text of the manuscripts in the selection process. For this reason, the articles written in languages other than English or Turkish (the native language of the researchers) and to which the researchers did not have full access were not included in the study. Furthermore, the articles that have a scope out of SRL were excluded. In this regard, we found that 2466 articles were totally irrelevant to the topic because of the abbreviation, SRL, which stands for diverse things apart from self-regulated learning. In addition, some publications addressed metacognition, self-efficacy, and self-regulation. The articles with these constructs were only included if they were related to SRL.

The intercoder agreement was sought in the selection of the articles for this study. The twelve Web of Science-produced Excel documents were used for coding. Of these documents, eleven of them include data for 500 publications, and one comprises data for 75 publications. Initially, the three researchers discussed the first data set, including 500 publications considering the eligibility criteria in a meeting. The remaining sets were examined and coded independently for inclusion and exclusion. Krippendorff’s alpha value was .94, showing a high rate of agreement among the three coders. The average pairwise percent agreement value was 97% among the three coders

for 15225 decisions. Moreover, any disagreement was solved in meetings through a careful discussion of the publications.

Figure 1

The Flow Diagram of the Study, Adapted from the PRISMA of Page et al. (2021)



Included Publications

Table 1 presents general statistics related to the included publications in the dataset. Specifically, this study involved a total of 2197 articles on SRL. The studies are published by 4724 authors between 1990 and 2021 in 647 different journals.

Table 1

Main Information about the Data from WOS with a Timespan 1990:2021

Description	Number
Documents (Articles)	2197
Authors	4724
Authors of multi-authored documents	4407
Single-authored documents	401
Sources (Journals)	647
Author's Keywords	3973
Keywords Plus	1984

The studies are mostly multi-authored papers (f = 4407). The articles overall included 3973 author keywords. The number of keywords plus, derived from the titles of the references of the included articles, is 1984.

Data Analysis

We analyzed the bibliographic metadata from the WOS database via the bibliometrix package (Aria & Cuccurullo, 2017) in the R programming language (R Core Team, 2021). The data were analyzed at six levels, including years, countries, authors, documents, sources, and keywords. The citation, collaboration, and co-occurrence network analyses were performed to explore the SRL publications included in the study. The analyses with the keywords were conducted after data cleaning for plurals, abbreviations, and conjugations, leading to a decrease in the number of the author's keywords from 3973 to 3940 and from 1984 to 1952 for keywords plus. Table 2 displays the data analysis outputs for the present study.

Table 2

Main Information about Data Analysis

Level of analysis	Analysis output
Years	Annual scientific production, Annual citation per year
Countries	Corresponding author's country, Most cited countries, Collaboration network based on countries
Authors	Most relevant authors, Authors' production over time, Author h-index
Documents	Most locally cited articles, Most globally cited articles
Sources	Most relevant journals, Most locally cited journals
Author Keywords	Most relevant keywords, Trend topics, Thematic map
Keywords Plus	Most relevant keywords

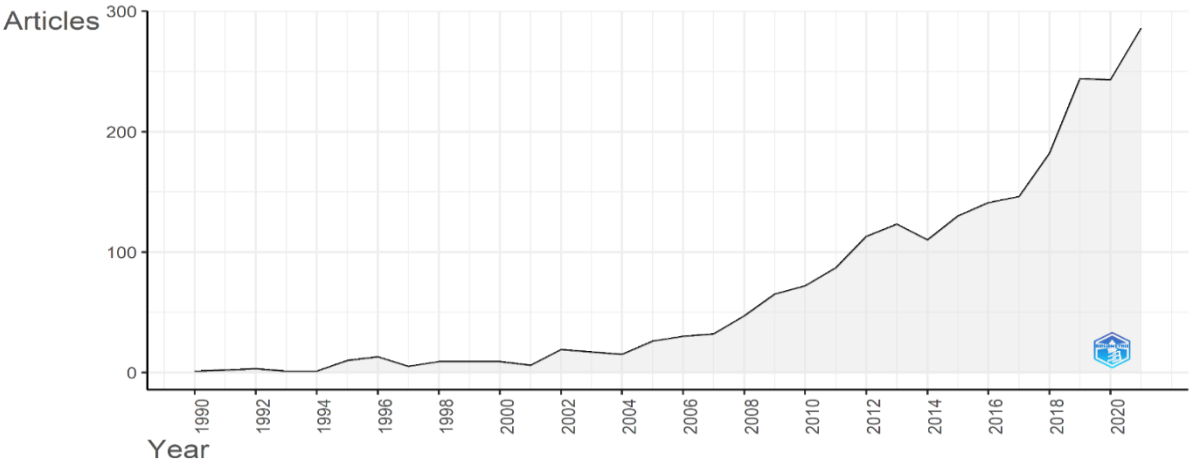
Results

Productivity and Citations over the Years

The present study offers results regarding the rate of annual production and average citations per year for the manuscripts retrieved from WOS on SRL. Of the 2197 analyzed papers, the first paper dates to 1990 (see Figure 2).

Figure 2

Annual Scientific Production



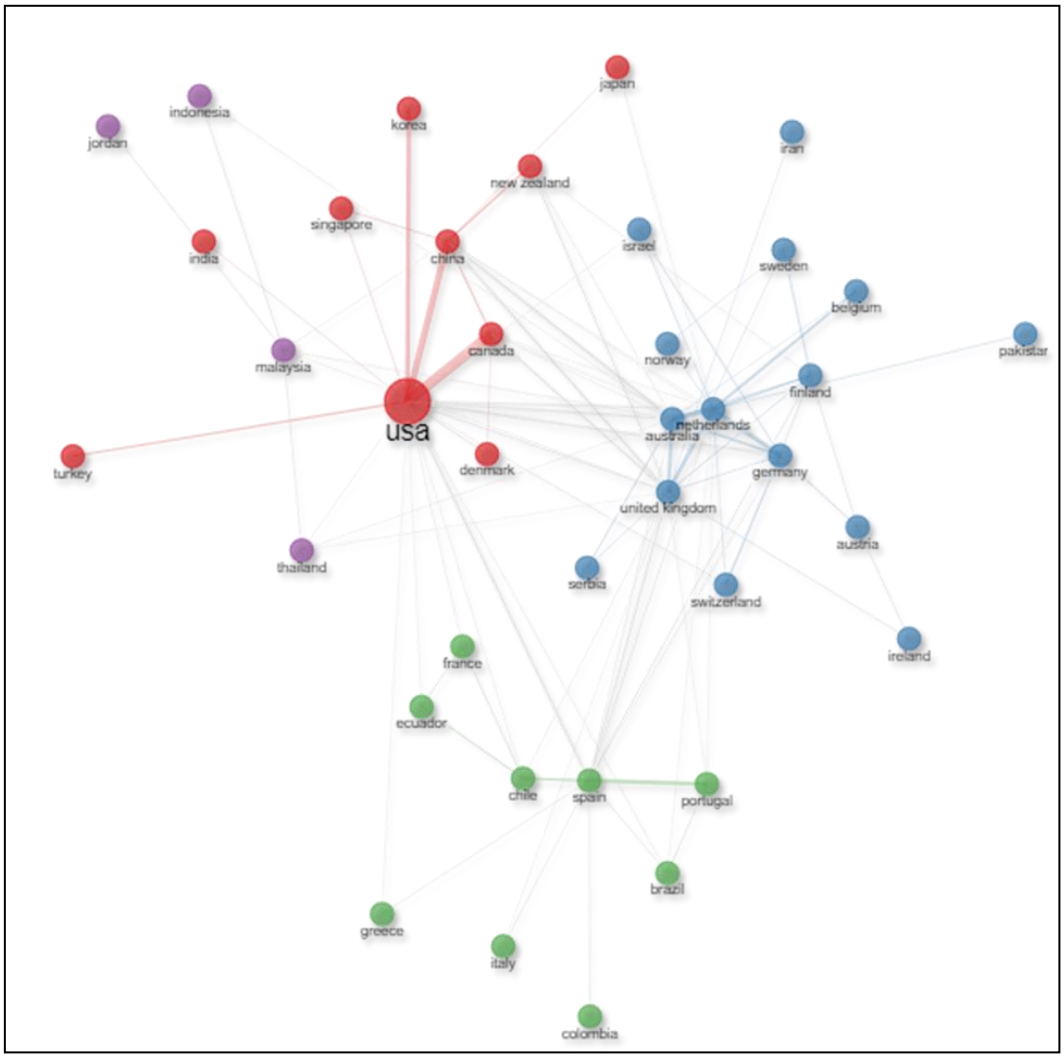
Except for a few minor declines, the production generally shows a trend of increase, especially from 2001 and onwards. The annual growth rate is 20% for annual scientific production. The production exceeds 100 papers by 2012 and reaches 286 manuscripts by 2021.

Countries and Collaboration

While the single-country publications dominate the literature on SRL, Figure 3 displays the results for the collaboration network based on countries. As the thickness of the lines in Figure 3 reflects, the SRL researchers from the USA collaborated mostly with researchers from Canada, followed by China and Korea. It appears that European countries are more likely to collaborate with each other, especially the collaborations between the United Kingdom and the Netherlands and between the Netherlands and Germany are remarkable. Australia has the most collaborations with the United Kingdom and the Netherlands as a country outside Europe.

Figure 3

Collaboration Network Based on Countries



In addition, the analyzed collection of the publications in the study represents 72 different countries. The results show that most of the publications (*f* = 564, 26%) were produced by the corresponding authors from the USA, followed by the publications of the corresponding authors from China (*f* =241, 11%) and Canada (*f* =143, 7%). The publications with the corresponding authors from the European region are mostly from Germany (*f* = 131, 6%), followed by the Netherlands (*f* = 121, 6%), and the United Kingdom (*f* = 88, 4%). Additionally, the three countries cited most in SRL research respectively involve the USA (*f* = 24610) with an average citation value of 43.63 per document, Canada (*f* = 5282) with an average citation value of 36.94 per document, and the Netherlands (*f* = 4375) with an average citation value of 36.16 per document. China, the second country concerning the number of corresponding authors, ranked sixth among the most cited countries with an average citation value of 12.60 per document. Table 3 presents the distribution of the SRL publications by the corresponding author's country and the most cited countries.

Table 3

Top Ten Countries by Corresponding Author's Country and Citations

R	Country by Corresponding Author	TP	%	R	Country by Citations	TC	AC_d
1	USA	564	26	1	USA	24610	43.63
2	China	241	11	2	Canada	5282	36.94
3	Canada	143	7	3	Netherlands	4375	36.16
4	Germany	131	6	4	United Kingdom	4155	47.22
5	Netherlands	121	6	5	Germany	3672	28.03
6	Australia	89	4	6	China	3037	12.60
7	United Kingdom	88	4	7	Australia	2274	25.55
8	Spain	76	4	8	Belgium	1435	34.17
9	Turkey	70	3	9	Spain	1169	15.38
10	Israel	51	2	10	Finland	1155	26.86

Note. R= "Ranking", TP = "Total Publications", TC= "Total Citations", AC_d = "Average Citations per Document"

Influential Authors

As shown in Figure 4, the two most relevant authors of SRL are Chia-Wen Tsai and Philip H. Winne, with their contributions to 25 publications closely followed by Roger Azevedo (*f* = 23).

The results also show that Winne has actively produced publications since 1993, while the remaining nine relevant authors have been active after 2001 (see Figure 5). When the most relevant ten authors' publications are examined between 2021 and 2022, the two authors with the highest number of publications recently are Dragan Gašević (*f* = 4) and Roger Azevedo (*f* = 3).

Figure 4

Most Relevant Authors

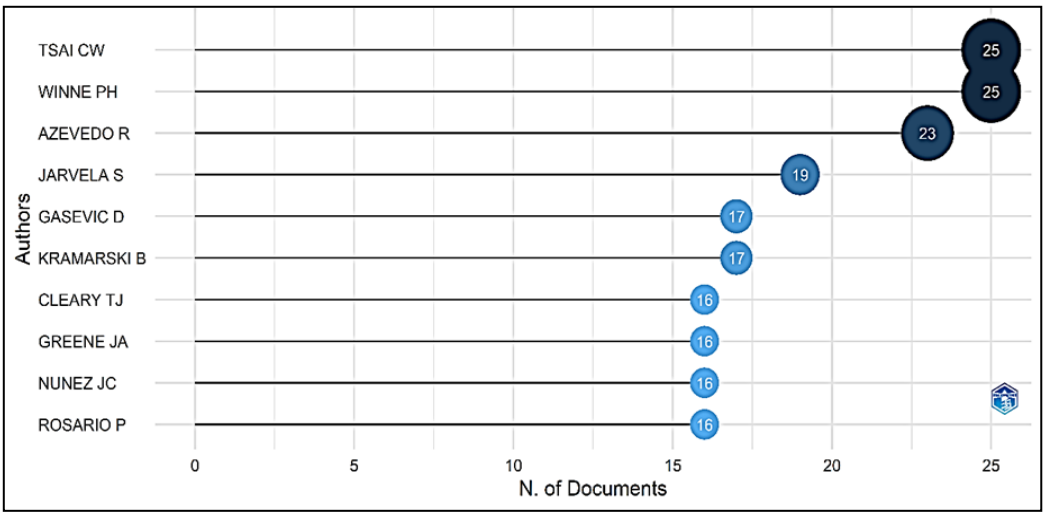
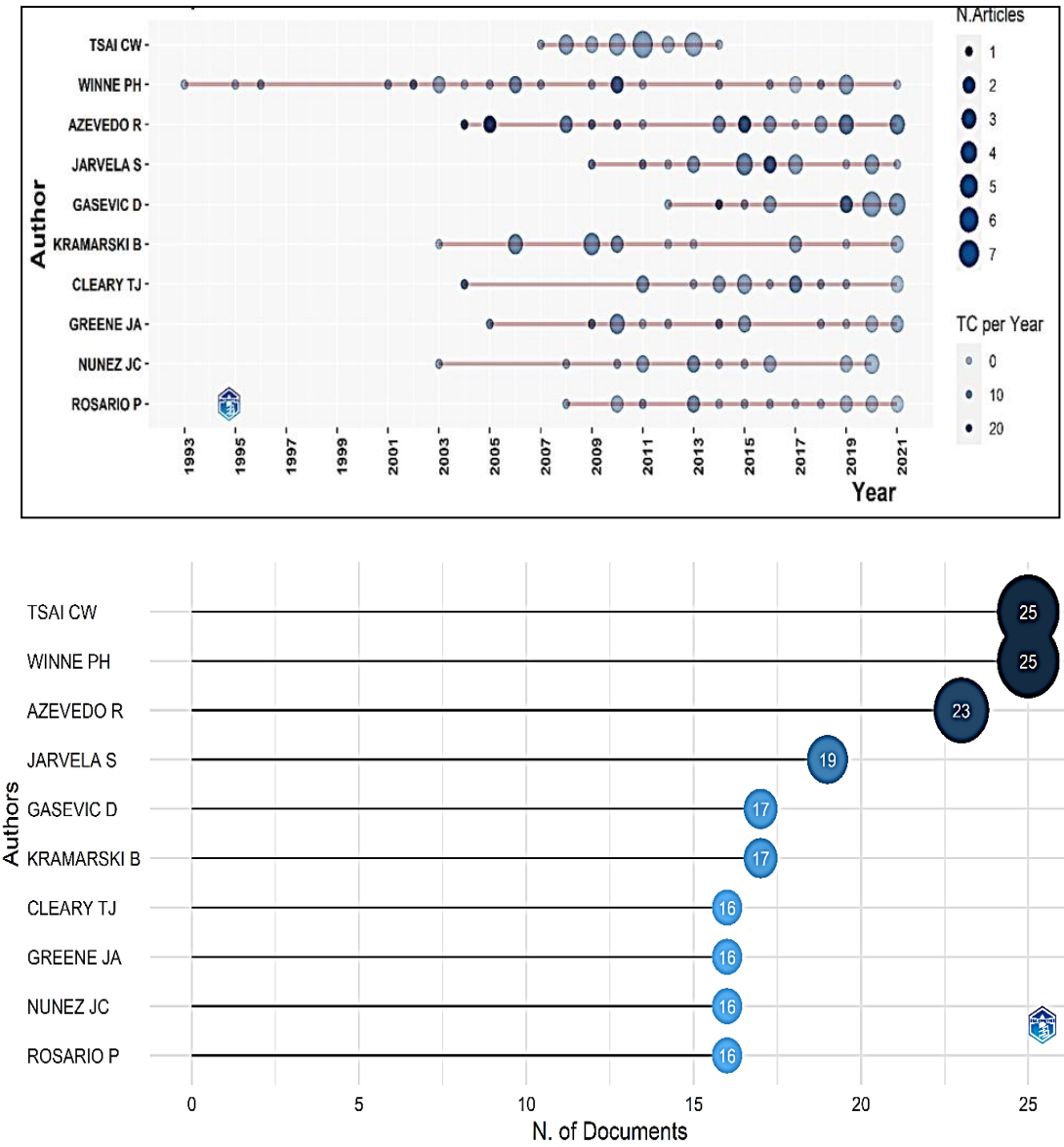


Figure 5

Top-Authors' Production Over Time



As a measure of author impact, Table 4 illustrates the authors with the top h-index in the analyzed collection of SRL papers. The results reveal that Roger Azevedo and Philip H. Winne are the most influential authors in SRL research, considering their h-index. Both Azevedo and Winne have 18 publications on SRL, each receiving at least 18 citations. Amongst the ten authors with the highest h-index, Azevedo and Winne also have the highest number of total citations (TC), each exceeding 1500.

Table 4

Author Impact

Author	h_index	TC	NP	PY_s
Azevedo R.	18	1882	23	2004
Winne P. H.	18	1501	23	1993
Tsai C. W.	14	441	25	2007
Artino A. R.	13	853	15	2008
Cleary T. J.	12	635	15	2004
Jarvela S.	12	668	19	2009
Greene J. A.	11	685	15	2005
Kramarski B.	10	548	17	2003
Littlejohn A.	10	597	11	2012
Paas F.	10	478	13	2004
Shen P. D.	10	321	15	2007
Wolters C. A.	10	1424	11	1996

Note. TC= "Total Citations", NP= "Number of Publications", PYs= "Publication Year start"

However, regardless of the h-index, the top author considering total citations is Barry J. Zimmerman (TC = 4401, h-index = 9) in SRL literature, followed by Debra Macfarlane-Dick (TC = 1952, h-index = 1) and David J. Nicol (TC = 1952, h-index= 1). After Azevedo, Monique Boekaerts (TC = 1804, h-index = 9) and Paul R. Pintrich (TC = 1723, h-index = 4) respectively ranked fifth and sixth regarding total citations in SRL research.

Top Documents

The most influential articles on SRL are determined considering their local and global citations (see Table 5). While local citations reveal the frequency of citations an article has received from the articles involved in the data set, global citations indicate the frequency of citations of an article in the whole WOS database.

Table 5

Top Five Documents by Local and Global Citations

R	Document by Local Citations	LC	R	Document by Global Citations	GC
1	"Zimmerman, B. J. (2008). Investigating Self-Regulation and Motivation: Historical Background, Methodological Developments, and Future Prospects. American Educational Research Journal."	340	1	"Nicol, D. J. & Macfarlane-Dick, D. (2006). Formative Assessment and Self-Regulated Learning: A Model and Seven Principles of Good Feedback Practice. Studies in Higher Education."	1952
2	"Pintrich, P. R. (2004). A Conceptual Framework for Assessing Motivation and Self-Regulated Learning in College Students. Educational Psychology Review."	284	2	"Zimmerman, B. J. (2008). Investigating Self-Regulation and Motivation: Historical Background, Methodological Developments, and Future Prospects. American Educational Research Journal."	1300
3	"Paris, S. G. & Paris, A. H. (2001). Classroom Applications of Research on Self-Regulated Learning. Educational Psychologist."	157	3	"Zimmerman, B. J. (2000). Self-Efficacy: An Essential Motive to Learn. Contemporary Educational Psychology."	1294
4	"Boekaerts, M. & Corno, L. (2005). Self-Regulation in the Classroom: A Perspective on Assessment and Intervention. Applied Psychology."	154	4	"Pintrich, P. R. (2004). A Conceptual Framework for Assessing Motivation and Self-Regulated Learning in College Students. Educational Psychology Review."	1106
5	"Dignath, C. & Büttner, G. (2008). Components of fostering self-regulated learning among students. A meta-analysis on intervention studies at primary and secondary school level. Metacognition and Learning."	133	5	"Zimmerman, B. J., Bandura, A., & Martinez-Pons, M. (1992). Self-Motivation for Academic Attainment: The Role of Self-Efficacy Beliefs and Personal Goal Setting. American Educational Research Journal."	1023

Note. R = "Ranking", LC = "Local Citations", GC = "Global Citations"

The results indicate that Barry J. Zimmerman's (2008) article, titled "Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects" has been cited most frequently by the articles in the collection of 2197 articles in the current study (LC = 1300), followed by Paul R. Pintrich's article (2004), titled "A conceptual framework for assessing motivation and

self-regulated learning in college students" (LC = 1106). These two articles are also placed among the five most globally cited articles list. The article titled "Formative assessment and self-regulated learning: A model and seven principles of good feedback practice (Nicol & Macfarlane-Dick, 2006)", had the most global citations in the present study.

Impactful Sources

Table 6 displays the results concerning the sources of the SRL articles in the sample of analyzed 2197 studies. In the present collection of 647 sources, the top five journals where articles were most frequently published are Learning and Individual Differences (*f* = 58, 3%), Frontiers in Psychology (*f* = 57, 3%), Computers and Education (*f* = 49, 2%), Metacognition and Learning (*f* = 49, 2%), and Computers in Human Behavior (*f* = 48, 2%). Moreover, in the present data set, there are 20441 cited sources. Amongst them, the source that is cited most by the studies is the Journal of Educational Psychology (*f* = 4586, 4%), followed by Contemporary Educational Psychology (*f* = 2139, 2%) and Educational Psychologist -US (*f* = 2073, 2%).

Table 6

Most Relevant and Most Locally Cited Sources

R	Most Relevant Sources	TP	%	R	Most Locally Cited Sources	TP	%
1	Learning and Individual Differences	58	3	1	Journal of Educational Psychology	4586	4
2	Frontiers in Psychology	57	3	2	Contemporary Educational Psychology	2139	2
3	Computers & Education	49	2	3	Educational Psychologist	2073	2
4	Metacognition and Learning	49	2	4	Handbook of Self-Regulation	1996	2
5	Computers in Human Behavior	48	2	5	Computers & Education	1732	2
6	Learning and Instruction	46	2	6	Learning and Instruction	1641	1
7	Educational Psychologist	32	2	7	Educational Psychology Review	1566	1
8	Journal of Educational Psychology	30	1	8	Review of Educational Research	1237	1
9	Contemporary Educational Psychology	29	1	9	Metacognition and Learning	1181	1
10	British Journal of Educational Psychology	28	1	10	Computers in Human Behavior	1126	1

Note. R= "Ranking", TP = "Total Publications"

Keywords Occurrence

The included publications on SRL were examined considering the occurrences of author's keywords and keywords plus (see Table 7). Excluding self-regulated learning and self-regulation, the five most frequently used author's keywords in the studies include motivation (*f* = 176), metacognition (*f* = 127), self-efficacy (*f* = 106), learning strategies (*f* = 105), and higher education (*f* = 86). As technology-related content, online learning (*f* = 64) and e-learning (*f* = 57) ranked seventh and eighth in the top ten list of author's keywords in SRL research. As regards the results for keywords plus, which shows the occurrence of the words in the titles of the references of the 2197 analyzed studies, the five most relevant words are identified as motivation (*f* = 529), performance (*f* = 383), student/students (*f* = 375), strategy/strategies (*f* = 363), and achievement (*f* = 346).

Table 7

Most Relevant Author Keywords and Keywords Plus

R	Most Relevant Author Keywords	f	R	Most Relevant Keywords Plus	f
1	Self-regulated learning	994	1	Motivation	529
2	Self-regulation	183	2	Performance	383
3	Motivation	176	3	Student/students	375
4	Metacognition	127	4	Strategy/strategies	363
5	Self-efficacy	106	5	Achievement	346
6	Learning strategies	105	6	Efficacy	261
7	Higher education	86	7	Classroom	201
8	Online learning	64	8	Education	199
9	E-learning	57	9	Model	191
10	Academic achievement	45	10	Knowledge	139

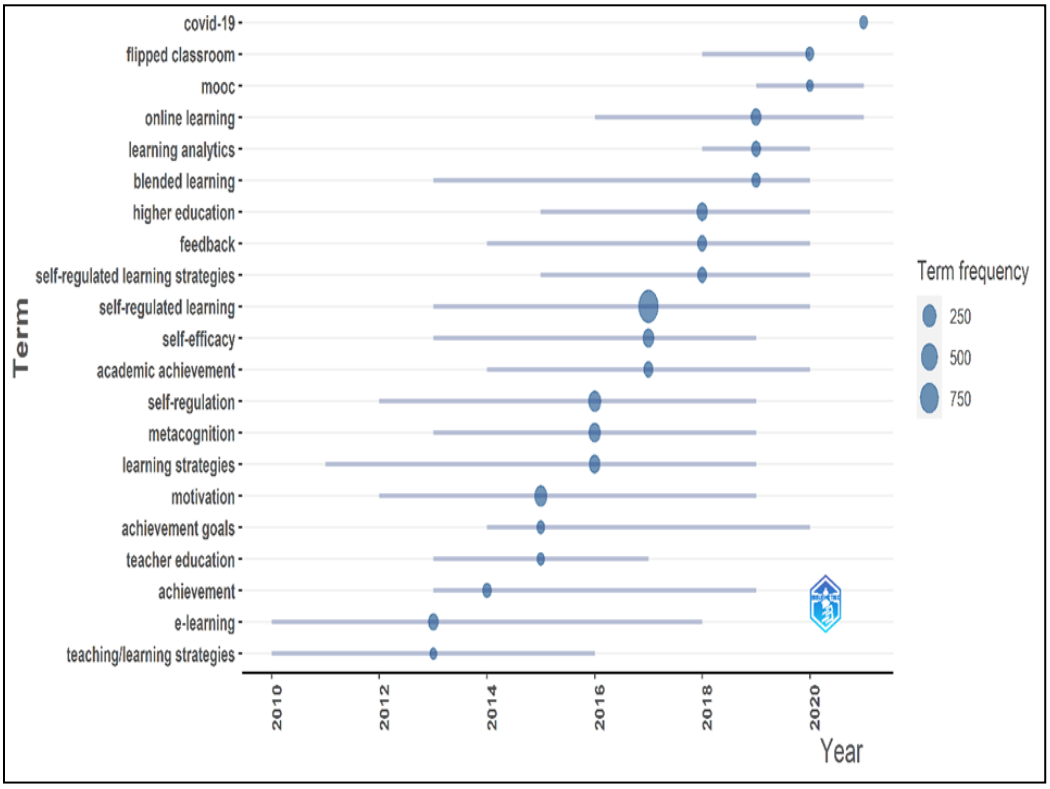
Note. R = "Ranking"

Trend Topics

The occurrences of the author's keywords were examined between 2010 and 2021 to highlight the focus of SRL research over the recent eleven years (see Figure 6). The analysis was performed with the author's keywords with at least 15 occurrences to unveil the contemporary topics that have been studied more frequently. The threshold for the number of words per year was set at 3.

Figure 6

Trend Topics between 2010 and 2021



The results indicate that the last decade's research on SRL has focused on a variety of topics, including "learning strategies," "motivation," "self-efficacy," "academic achievement/achievement," and "metacognition." Also, publications on different aspects of technology-enhanced learning, such as "online learning," "blended learning," and "e-learning" have occupied an important place over the last eleven years in the SRL field. Especially, the studies on "learning analytics" (f = 39 in 2019), "flipped classroom" (f = 23 in 2020), and "MOOC" (f = 15 in 2020) have been noteworthy since 2018. "Covid-19" has been the salient keyword of 2021 (f = 19).

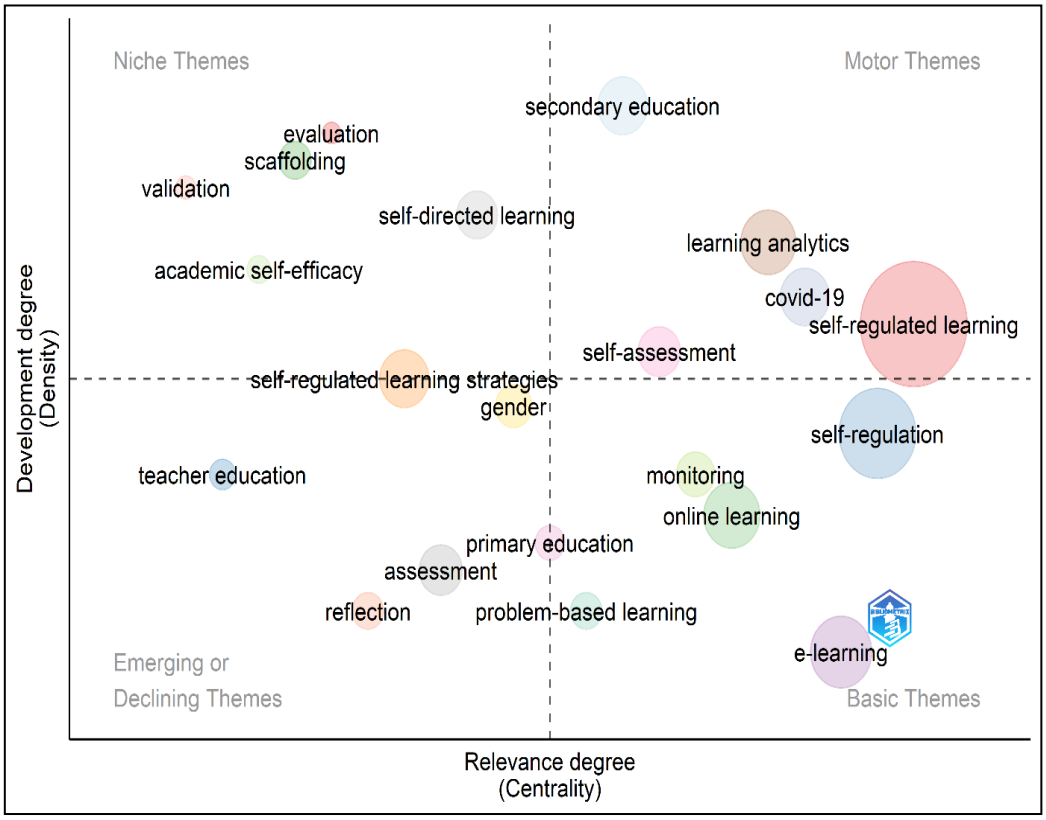
Conceptual Structure

A thematic map is provided based on the author's keywords (see Figure 7) to show the important themes in the SRL field. Considering the suggestion of Aria et al. (2021), the Louvain community detection algorithm was applied, and the results were interpreted based on Callon centrality and density values. All identified author's keywords (n = 3940) were included in the analysis. On the map, while the X-axis, representing the centrality, is a measure of interaction among the themes, the Y-axis,

standing for density, indicates the internal strength of a theme. The thematic map overall represents 21 clusters in the present study.

Figure 7

Thematic Map of Author's Keywords for SRL Research



The first quadrant (high centrality, high density) shows the well-developed themes for the SRL field. These themes also have important links with other themes on the map. Five motor themes are identified in this quadrant in the present study. The cluster with the highest word occurrence (f = 1991) in this quadrant comprises 34 words. The five most frequently co-occurring words in this developed cluster are "self-regulated learning," "motivation," "metacognition," "self-efficacy," and "learning strategies." The cluster with the second highest word occurrence (f = 90) in the first quadrant includes the co-occurring words "learning analytics," "goal orientation," "collaborative learning," "workplace learning," and "process mining." The other three developed and important clusters for the SRL research include (1) the cluster with the co-occurring words "self-assessment" and "problem-solving," (2) the cluster with the co-occurring words "Covid 19," "learning environment," and "self-determination theory," and "distance learning," and (3) the cluster with the co-occurring words "secondary education," "teaching/learning strategies," "interactive learning environments," "self-regulated learning skills," and "intelligent tutoring skills."

The second quadrant (low centrality, high density) reveals the developed themes that do not have strong external links with other themes on the map. The results present five isolated themes in the present study. In this quadrant, one isolated cluster includes the words "self-directed learning," "instructional design," and "active learning." The

other four isolated clusters involve (1) the cluster with co-occurring words "scaffolding" and "learning achievement," (2) the cluster with the word "academic self-efficacy," (3) the cluster with the word "validation," and (4) the cluster with the word "evaluation." It must be noted that the cluster with co-occurring words "self-regulated learning strategies," "learning outcomes," and "epistemological beliefs" is positioned between the second and the third quadrant; therefore, it is not interpreted.

The third quadrant (low centrality, low density) involves the weakly developed and marginal themes. The thematic map plots four themes in this quadrant. The cluster with the highest word occurrence (f = 44) includes the recurrent words "assessment" and "structural equation modeling." The other emerging or declining three clusters in this quadrant include (1) the cluster with co-occurring words "gender" and "distance education," (2) the cluster with the word "teacher education," and (3) the cluster with the word "reflection." The cluster with the word "primary education" is identified between the third and the fourth quadrant.

The fourth quadrant (high centrality, low density) represents the clusters likely to be transversal to different research areas. There are five clusters in this quadrant in the present study. The cluster with the highest word occurrence (f = 332) includes the words "self-regulation," "learning," "formative assessment," and "medical student" as the most co-occurring four terms. The other basic four themes for the SRL field include (1) the cluster with the co-occurring words "e-learning," "feedback," and "blended learning," (2) the cluster with the co-occurring words "online learning," "satisfaction," and "MOOC," (3) the cluster with the co-occurring words "monitoring" and "education," and (4) the cluster with the word "problem-based learning."

Discussion and Conclusion

The current study presents an overview of SRL research based on the 2197 articles included in the WoS database. The paper overall presents imperative findings regarding scientific productivity over the years, the most contributing countries, authors, articles, and journals to the SRL literature, and the influential topics and themes in the field. As expected, the results indicate that the number of manuscripts on SRL has risen in the field over 32 years between 1990 and 2021. Based on this growing trend of productivity, especially from 2001 and onwards, it can be claimed that SRL has constituted an important area of study in educational research since the beginning of the second millennium. Why SRL has gained increased attention with the beginning of the 21st century can be attributed to the characteristics of this era that has made us rethink learning, teaching, and the education of individuals. As Trilling and Fadel (2009) explain, with the shift from Industrial Age to Knowledge Age in the 21st century, the development of the so-called 21st-century skills has been an important aim for countries to meet the demands and achieve progress. As part of the 21st-century skills, individuals are expected to manage goals and time, work autonomously, direct their learning, expand their learning, and show commitment to learning as a lifelong process (Trilling & Fadel, 2009).

The results indicate that the three prominent countries in SRL research are the USA, China, and Canada, given the number of publications by the corresponding author's country in the analyzed collection of the articles. Several European countries, including Germany, the Netherlands, and the United Kingdom, have also contributed to

the SRL literature, albeit less frequently than these three countries. The previous studies have consistently mentioned that the USA produces most of the scientific publications in all fields in the world (e.g., Man et al., 2004; Tasli et al., 2012). There may be an interconnectedness between SRL research, the development of 21st-century skills, and the broader goals of societal progress and economic advancement. It can be argued that the countries that produce most in SRL are strategically aligning themselves with the needs and demands of the 21st century, where the ability to learn, adapt, and innovate are increasingly crucial for success. By valuing and prioritizing SRL research, these countries may demonstrate their commitment to fostering a highly skilled workforce, promoting lifelong learning, and preparing individuals to thrive in a knowledge-based economy. Furthermore, scientific productivity often reflects factors such as research funding allocation, scholars' work conditions, and researchers' qualifications in countries (Tasli et al., 2012). Moreover, Man et al. (2004) argue that scholars from English-speaking countries may have a distinct language advantage in publishing their studies, as many journals accept articles written in English. It seems that China, emerging as an influential country in the context of SRL research, has effectively overcome language barriers for publication. China's scientific productivity can also be attributed to the government's efforts to improve the reputation of the universities since 1998, including encouraging higher education institutions to publish in internationally refereed journals and attracting talented scholars to work in Chinese universities (Yang & You, 2018).

Knowing the leading authors and their research is considered important for scholars to gain insights into the basics, guiding ideas, and the areas open to improvement in a field of study. The impactful documents in a research area can lay the foundation for more innovative studies; thus, they constitute the primary sources to refer to in a research study. In the present study, the three giants of the SRL field are identified as Chia-Wen Tsai, Philip H. Winne, and Roger Azevedo, considering their number of publications and h-index. Winne's studies are likely to focus on the cognitive and metacognitive dimensions of SRL. Apparently, Tsai has been more interested in the study of SRL in relation to web-based and online learning. The featured topics of Azevedo's studies on SRL include scaffolding and hypermedia learning. Among these authors, Winne can be introduced as the pioneer of SRL research as he produced the earliest publications and has been studying SRL for a longer time compared to Tsai and Avezedo.

In addition, this study shows that scholars should pay attention to the work of Barry J. Zimmerman, the scholar with the most total citations, and especially to his manuscript on self-regulation and motivation, the most cited document in the analyzed set of documents in the present study. Schunk and Usher (2013) similarly recognized the legacy of Zimmerman for the SRL research as they figured out that Zimmerman has made remarkable contributions to the development of SRL research by building a social-cognitive theory of SRL, explaining the operation of self-regulatory processes, and offering applications for improving student achievement based on the SRL processes. Moreover, as the second most locally cited publication in the present study, Paul R. Pintrich's publication on assessing motivation and SRL requires close examination. This seminal work presents a conceptual framework from the SRL perspective for developing tools to determine college students' motivation and learning

and discusses its relation to the "Motivated Strategies for Learning Questionnaire (MSLQ)." Schunk (2005) as well introduces Pintrich as a prominent figure in SRL research by touching on some of his major contributions, such as developing a conceptual framework regarding the phases of SRL, explaining the role of motivation in SRL, examining the influence of classrooms and schools and the interventions on self-regulatory processes, and developing MSLQ to measure SRL. Furthermore, the current study highlights the study by David J. Nicol and Debra Macfarlane-Dick on formative assessment and SRL as the document with the most global citations. This influential publication mainly discusses the seven principles of effective feedback to support SRL. The impact of this article in the field is likely to show that formative assessment and feedback comprise a distinct and significant area of research in SRL literature.

The keyword analysis in the present study helps us understand what has been at the heart of the research in the SRL literature to date. The results for the author's keywords demonstrate that the studies on SRL have been more frequently conducted in relation to motivation, metacognition, self-efficacy, and learning strategies. In addition, considering the thematic analysis results, these five terms frequently co-occur in author's keywords and form a well-developed theme that connects with other defined themes in the present study. These results are expected considering that the terms, "motivation", "metacognition," "self-efficacy," and "learning strategies" comprise the main characteristics that define SRL, which is about an individual's capability to monitor and control cognition and motivational beliefs including self-efficacy and to use strategies that result in better performance (Pintrich, 1995). Moreover, the results regarding both author's keywords and keywords plus indicate that achievement or performance are remarkable terms frequently occurring in SRL research. It can be claimed that to what extent and how SRL is related to an individual's academic achievement or performance have constituted important questions in SRL research.

Based on the results for the keywords plus, it must be noted that SRL has often been studied in the context of classrooms and with students. Among different levels of education, it seems that higher education has been an area SRL researchers have examined more frequently than primary and secondary education levels. The results indicate that "medical students" constitute a special target group for SRL research at the higher education level. The existence of earlier review studies on SRL in medicine education (e.g., Cho et al., 2017; van Houten-Schat et al., 2018) consistently supports the argument that medicine education is an important strand in SRL research. Cassidy (2011) similarly underlines that SRL is a considerably relevant concept in higher education. The scholars' interest in higher education for the study of SRL may be because college students are highly expected to take ownership of their learning and be autonomous and lifelong learners. Yet supporting students' self-regulated learning before higher education could produce more fruitful results for learning and performance.

The analyzed studies' publication frequently in Learning and Individual Differences: Journal of Psychology and Education, Frontiers in Psychology, and Metacognition and Learning indicate that SRL is a main topic of educational psychology. Yet two journals among the five most relevant journals in the present study are Computers and Education and Computers in Human Behavior, which means SRL is also a topic of educational technology. The results provide clear evidence that SRL has

often been examined in relation to technology-based contexts such as online learning, e-learning, blended learning, flipped classrooms, MOOC, and learning analytics. The existence of several review studies on SRL and different aspects of technological environments (e.g., Broadbent & Poon, 2015; Garcia et al., 2018; Guo, 2022; Villatoro Moral & De Benito, 2021) is considered compatible with this finding. In today's digital world, the increased interest in integrating technology into education and the rising value of distant and open education in the current era may explain the interest in studying technology-enhanced learning environments in SRL research. These environments, by their nature, are highly relevant to SRL research because they are less teacher-centered and more learner-centered, which makes the use of self-regulatory skills more critical for achieving goals (Steffens, 2006).

Implications

Since developing self-reliant and independent learners remains a requirement and challenge for societies, SRL is expected to remain an important construct in educational research. It is recommended that researchers examine the studies of the influential authors in the filed when planning their research on SRL. Notable researchers such as Chia-Wen Tsai, Philip H. Winne, Roger Azevedo, Barry J. Zimmerman, and Paul R. Pintrich have made significant contributions to the study of SRL and can serve as valuable sources of insights and inspiration for future investigations. Although the results underline some collaborations between the countries, it seems that single-country publications are still dominant in the field of SRL. Future research that adopts a cross-cultural study approach can increase our knowledge about the influence of culture on self-regulatory processes. In the present study, the word "primary education" or "young learners" do not occur as frequently as the words "higher education" or "college students," which is likely to show a need for delving more into the study of SRL in early grades in future research.

Notably, the less frequently occurring and co-occurring terms and the less developed and important themes in SRL research offer significant implications for future research. Given the phases of SRL defined by Zimmerman (2002), the keywords related to the self-reflection phase, such as "self-evaluation," "causal attribution," "self-satisfaction," and "affect regarding performance," have occurred less frequently in the analyzed collection of the studies in the present research, compared to the keywords related to forethought and performance phases. In support of this argument, despite being an important component of SRL, the results show that "reflection" is an emerging or declining theme in the SRL field. This underscores the importance of giving more consideration to the self-reflection phase and exploring its role and impact on self-regulated learning processes in depth. Also, it must be noted that SRL, an important construct for teaching, has been less frequently explored in teacher education, one of the themes that appear in the third quadrant of the thematic map in the present study. Future studies can increase our understanding of teacher education curriculum and course practices concerning the support for teacher candidates' self-regulated learning and the effective ways for developing teacher candidates' qualifications for teaching SRL in the future.

The study is limited to studies written in English and Turkish. The search was restricted to the WoS database. Scholars can replicate this study with other databases

and languages. Moreover, this study started at the beginning of 2022, and therefore, the studies conducted in 2022 could not be included in the analyses. It is important to focus on the studies from 2022 onwards in subsequent bibliometric analyses to identify developments and changes in the field.

Acknowledgements

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Statement of Responsibility

Dr. Rahime Cobanoglu contributed to the conceptualization of the paper, methodology, literature review, examination-selection of the studies with respect to the inclusion criteria, interpretation and discussion of the results, and writing-editing process.

Dr. Serap Buyukkidik contributed to the conceptualization of the paper, methodology, examination-selection of the studies with respect to the inclusion criteria, data analysis and visualization with R programme, interpretation of the results, and writing-editing process.

Dr. Gulfem D. Yurttas Kumlu contributed to the conceptualization of the paper, methodology, literature review, examination-selection of the studies with respect to the inclusion criteria, interpretation of results, and writing-editing process.

Conflicts of Interest

The authors declare that they have no personal and financial conflict of interest associated with this publication to disclose.

Author Bios:

Dr. Rahime Cobanoglu obtained her MS and PhD degrees in Curriculum and Instruction at Middle East Technical University, Türkiye. In her dissertation, she conducted a mixed-methods research on teacher-child interaction quality in preschool classrooms. During her graduate education, she studied at Utrecht University in the Netherlands as an Erasmus student for a semester and at Indiana University, Bloomington in the USA for eleven months as a visiting scholar. She presented several papers at international educational conferences such as Annual Meeting of American Educational Research Association and European Conference on Educational Research. Her research interests include teacher beliefs, teacher efficacy, teacher practices, early childhood education quality, curriculum implementation, and hidden curriculum. She offers a range of courses for teacher education programs such as Principles and Methods of Teaching, Educational Philosophies, Extra Curriculum Activities, and Introduction to Education. She currently works as an Assistant Professor of Educational Sciences at Sinop University, Türkiye.

Dr. Serap Buyukkidik graduated from Hacettepe University, Department of Mathematics Education in 2010. She received a scholarship from the Ministry of Education during her undergraduate education. She completed her Master's degree in Educational Measurement and Evaluation at Hacettepe University in 2012. She was supported by The Scientific and Technological Research Council of Turkey

(TÜBİTAK) with 2228/A Graduate Scholarship Program. She successfully completed her PhD at Gazi University in the field of Educational Measurement and Evaluation, with the 2211/A PhD Scholarship Program of TÜBİTAK. During her Ph.D. study, in 2018, she obtained the support of TÜBİTAK-2214/A International Research Fellowship and studied with Prof. Dr. Mark J. Gierl at the University of Alberta faculty member in Centre for Research in Applied Measurement and Evaluation. She has several articles published in SSCI, ESCI, and other international/national indexed journals. She is currently a faculty member at the Department of Educational Sciences at Sinop University.

Dr. Gulfem D. Yurttas Kumlu graduated from the Department of Science Education in 2007. She obtained her Master's Degree in Science Education at Muğla University in 2010 and completed her PhD degree in the same area at Gazi University in 2016. She investigated the impact of explicit reading strategy instruction and peer tutoring on pre-service science teachers' conceptual understanding about heat-temperature via qualitative methods in her doctoral dissertation. She also obtained Master's Degree in Educational Measurement and Evaluation at Hacettepe University in 2018. She worked as a research assistant at Muğla University, Sinop University, and Gazi University. She currently works at the department of Science Education at Sinop University. She carries out research on science education, concept teaching, misconceptions, conceptual change, metacognition, cognitive and metacognitive strategies, and metaconceptual activities. She has offered various courses such as Science Laboratory Practices, Instructional Technologies and Material Design, Teaching Practices and Scientific Reasoning Skills.

References

Alonso-Mencía, M. E., Alario-Hoyos, C., Maldonado-Mahauad, J., Estévez-Ayres, I., Pérez-Sanagustín, M., & Delgado Kloos, C. (2020). Self-regulated learning in MOOCs: Lessons learned from a literature review. *Educational Review*, *72*(3), 319-345. https://doi.org/10.1080/00131911.2019.1566208

Andres, A. (2009). *Measuring academic research. How to undertake a bibliometric study*. Chandos publishing.

Anthonysamy, L., Koo, A. C., & Hew, S. H. (2020). Self-regulated learning strategies and non-academic outcomes in higher education blended learning environments: A one decade review. *Education and Information Technologies*, *25*(5), 3677-3704. https://doi.org/10.1007/s10639-020-10134-2

Araka, E., Maina, E., Gitonga, R., & Oboko, R. (2020). Research trends in measurement and intervention tools for self-regulated learning for e-learning environments-systematic review (2008-2018). *Research and Practice in Technology Enhanced Learning*, *15*(1), 1-21. https://doi.org/10.1186/s41039-020-00129-5

Aria, M., & Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, *11*(4), 959-975. https://doi.org/10.1016/j.joi.2017.08.007

Aria, M., Alterisio, A., Scandurra, A., Pinelli C., & D'Aniello, B. (2021). The scholar's best friend: research trends in dog cognitive and behavioural studies. *Animal Cognition*, *24*, 541-553. https://doi.org/10.1007/s10071-020-01448-2

Blackmore, C., Vitali, J., Ainscough, L., Langfield, T., & Colthorpe, K. (2021). A review of self-regulated learning and self-efficacy: The key to tertiary transition in science, technology, engineering and mathematics (STEM). *International Journal of Higher Education*, *10*(3), 169-177. https://doi.org/10.5430/ijhe.v10n3p169

Boekaerts, M. (1999). Self-regulated learning: Where we are today. *International Journal of Educational Research*, *31*(6), 445-457. https://doi.org/10.1016/S0883-0355(99)00014-2

Broadbent, J., & Poon, W. L. (2015). Self-regulated learning strategies & academic achievement in online higher education learning environments: A systematic review. *The Internet and Higher Education*, *27*, 1-13. http://dx.doi.org/10.1016/j.iheduc.2015.04.007

Cassidy, S. (2011). Self-regulated learning in higher education: Identifying key component processes. *Studies in Higher Education*, *36*(8), 989-1000. https://doi.org/10.1080/03075079.2010.503269

Cho, K. K., Marjadi, B., Langendyk, V., & Hu, W. (2017). The self-regulated learning of medical students in the clinical environment-a scoping review. *BMC Medical Education*, *17*(1), 1-13. https://doi.org/10.1186/s12909-017-0956-6

Dignath, C., & Veenman, M. V. (2021). The role of direct strategy instruction and indirect activation of self-regulated learning-Evidence from classroom observation studies. *Educational Psychology Review*, *33*(2), 489-533. https://doi.org/10.1007/s10648-020-09534-0

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, *133*, 285-296. https://doi.org/10.1016/j.jbusres.2021.04.070

Ellegaard, O., & Wallin, J. A. (2015). The bibliometric analysis of scholarly production: How great is the impact?. *Scientometrics*, *105*(3), 1809-1831. https://doi.org/10.1007/s11192-015-1645-z

Ergen, B., & Kanadli, S. (2017). The effect of self-regulated learning strategies on academic achievement: A meta-analysis study. *Eurasian Journal of Educational Research*, *17*(69), 55-74. http://dx.doi.org/10.14689/ejer.2017.69.4

Gambo, Y., & Shakir, M. Z. (2021). Review on self-regulated learning in smart learning environment. *Smart Learning Environments*, *8*(12), 1-14. https://doi.org/10.1186/s40561-021-00157-8

Garcia, R., Falkner, K., & Vivian, R. (2018). Systematic literature review: Self-regulated learning strategies using e-learning tools for Computer Science. *Computers & Education*, *123*, 150-163. https://doi.org/10.1016/j.compedu.2018.05.006

Guo, L. (2022). Using metacognitive prompts to enhance self-regulated learning and learning outcomes: A meta-analysis of experimental studies in computer-based learning environments. *Journal of Computer Assisted Learning*, *38*(3), 811-832. http://doi.org/10.1111/jcal.12650

Hooshyar, D., Pedaste, M., Saks, K., Leijen, Ä., Bardone, E., & Wang, M. (2020). Open learner models in supporting self-regulated learning in higher education: A

systematic literature review. *Computers & Education*, *154*(103878), 1-19. https://doi.org/10.1016/j.compedu.2020.103878

Lee, D., Lee-Watson, S., & Watson, W. R. (2019). Systematic literature review on self-regulated learning in massive open online courses. *Australasian Journal of Educational Technology*, *35*(1), 28-41. https://doi.org/10.14742/ajet.3749

Lim, S. L., & Yeo, K. J. (2021). The relationship between motivational constructs and self-regulated learning: A review of literature. *International Journal of Evaluation and Research in Education*, *10*(1), 330-335. https://doi.org/10.11591/ijere.v10i1.21006

Linnenluecke, M. K., Marrone, M., & Singh, A. K. (2020). Conducting systematic literature reviews and bibliometric analyses. *Australian Journal of Management*, *45*(2), 175-194. https://doi.org/10.1177/0312896219877678

Man, J. P., Weinkauf, J. G., Tsang, M., & Sin, J. H. D. D. (2004). Why do some countries publish more than others? An international comparison of research funding, English proficiency and publication output in highly ranked general medical journals. *European Journal of Epidemiology*, *19*(8), 811-817. https://doi.org/10.1023/B:EJEP.0000036571.00320.b8

Matcha, W., Gašević, D., & Pardo, A. (2019). A systematic review of empirical studies on learning analytics dashboards: A self-regulated learning perspective. *IEEE Transactions on Learning Technologies*, *13*(2), 226-245. https://doi.org/10.1109/TLT.2019.2916802

Mejia, C., & Kajikawa, Y. (2017). Bibliometric analysis of social robotics research: identifying research trends and knowledgebase. *Applied Sciences*, *7*(12), 1316. https://doi.org/10.3390/app7121316

Min, H., & Nasir, M. K. M. (2020). Self-regulated learning in a massive open online course: A review of literature. *European Journal of Interactive Multimedia and Education*, *1*(2), 1-6. https://doi.org/10.30935/ejimed/8403

Mlott, S. R., Marcotte, D. B., & Lira, F. T. (1976). The efficacy of programmed instruction in the training of paraprofessionals. *Journal of Clinical Psychology*, *32*(2), 419-424. https://doi.org/10.1002/1097-4679(197604)32:2<419::aid-jclp2270320246>3.0.co;2-1

Moos, D. C., & Ringdal, A. (2012). Self-regulated learning in the classroom: A literature review on the teacher's role. *Education Research International*, *2012*, 1-15. https://doi.org/10.1155/2012/423284

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *International Journal of Surgery*, *10*(89), 1-11. https://doi.org/10.1186/s13643-021-01626-4

Palalas, A., & Wark, N. (2020). The relationship between mobile learning and self-regulated learning: A systematic review. *Australasian Journal of Educational Technology*, *36*(4), 151-172. https://doi.org/10.14742/ajet.5650

Panadero, E. (2017). A review of self-regulated learning: Six models and four directions for research. *Frontiers in Psychology*, *8*, 1-28. https://doi.org/10.3389/fpsyg.2017.00422

Panadero, E., Jonsson, A., & Botella, J. (2017). Effects of self-assessment on self-regulated learning and self-efficacy: Four meta-analyses. *Educational Research Review*, *22*, 74-98. https://doi.org/10.1016/j.edurev.2017.08.004

Paris, S. G., & Newman, R. S. (1990). Development aspects of self-regulated learning. *Educational Psychologist*, *25*(1), 87-102. https://doi.org/10.1207/s15326985ep2501_7

Paris, S. G., & Paris, A. H. (2001). Classroom applications of research on self-regulated learning. *Educational Psychologist*, *36*(2), 89-101. https://doi.org/10.1207/S15326985EP3602_4

Pintrich, P. R. (1995). Understanding self-regulated learning. *New Directions for Teaching and Learning*, *1995*(63), 3-12. https://doi.org/10.1002/tl.37219956304

Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review*, *16*(4), 385-407. https://doi.org/10.1007/s10648-004-0006-x

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, *82*(1), 33-40. https://doi.org/10.1037/0022-0663.82.1.33

Pintrich, P. R., Smith, D. A., Garcia, T., & McKeachie, W. J. (1993). Reliability and predictive validity of the Motivated Strategies for Learning Questionnaire (MSLQ). *Educational and Psychological Measurement*, *53*(3), 801-813. https://doi.org/10.1177/0013164493053003024

Puustinen, M., & Pulkkinen, L. (2001). Models of self-regulated learning: A review. *Scandinavian Journal of Educational Research*, *45*(3), 269-286. https://doi.org/10.1080/00313830120074206

R Core Team. (2021). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing.

Rasheed, R. A., Kamsin, A., Abdullah, N. A., Kakudi, H. A., Ali, A. S., Musa, A. S., & Yahaya, A. S. (2020). Self-regulated learning in flipped classrooms: A systematic literature review. *International Journal of Information and Education Technology*, *10*(11), 848-853. https://doi.org/10.18178/ijiet.2020.10.11.1469

Saavedra, A. R., & Opfer, V. D. (2012). Learning 21st-century skills requires 21st-century teaching. *Phi Delta Kappan*, *94*(2), 8-13. https://doi.org/10.1177/003172171209400203

Saepulmilah, C., & Azhari, S. C. (2022). Analisis Perkembangan literature self-regulated learning dari tahun 2017-2021 Menggunakan bibliometric analysis. *Jurnal Pendidikan dan Konseling*, *4(*4), 2132-2141. https://doi.org/10.31004/jpdk.v4i4.5632

Schunk, D. H. (2005). Self-regulated learning: The educational legacy of Paul R. Pintrich. *Educational Psychologist*, *40*(2), 85-94. https://doi.org/10.1207/s15326985ep4002_3

Schunk, D. H., & Greene, J. A. (2018). Historical, contemporary, and future perspectives on self-regulated learning and performance. In D. H. Schunk & J. A. Greene (Eds.), *Handbook of self-regulation of learning and performance* (2nd ed., pp. 10-22). Routledge.

Schunk, D. H., & Usher, E. L. (2013). Barry J. Zimmerman's theory of self-regulated learning. In H. Bembenutty, T. J. Cleary, A., & Kitsantas (Eds.), *Applications of self-regulated learning across diverse disciplines: A tribute to Barry J. Zimmerman* (pp. 1-28). Information Age.

Steffens, K. (2006). Self-regulated learning in technology-enhanced learning environments: Lessons of a European peer review. *European Journal of Education, 41*(3-4), 353-379. https://doi.org/10.1111/j.1465-3435.2006.00271.x

Tasli, L., Kacar, N., & Aydemir, E. H. (2012). Scientific productivity of OECD countries in dermatology journals within the last 10-year period. *International Journal of Dermatology*, *51*(6), 665-671. https://doi.org/10.1111/j.1365-4632.2011.05112.x

Theobald, M. (2021). Self-regulated learning training programs enhance university students' academic performance, self-regulated learning strategies, and motivation: A meta-analysis. *Contemporary Educational Psychology*, *66* (101976), 1-19. https://doi.org/10.1016/j.cedpsych.2021.101976

Torrano Montalvo, F., & González Torres, M. (2004). Self-regulated learning: Current and future directions. *Electronic Journal of Research in Educational Psychology*, *2(*1), 1-34. http://repositorio.ual.es/bitstream/handle/10835/671/Art_3_27_eng.pdf?sequenc

Trilling, B., & Fadel, C. (2009). *21st century skills: Learning for life in our times*. John Wiley & Sons.

van Houten-Schat, M. A., Berkhout, J. J., van Dijk, N., Endedijk, M. D., Jaarsma, A. D. C., & Diemers, A. D. (2018). Self-regulated learning in the clinical context: A systematic review. *Medical Education*, *52*(10), 1008-1015. https://doi.org/10.1111/medu.13615

Villatoro Moral, S., & De Benito, B. (2021). An approach to co-design and self-regulated learning in technological environments. *Journal of New Approaches in Educational Research, 10*(2), 234-250. https://doi.org/10.7821/naer.2021.7.646

Winne, P. H. (1995). Inherent details in self-regulated learning. *Educational Psychologist*, *30*(4), 173-187. https://doi.org/10.1207/s15326985ep3004_2

Winne, P. H. (2005). A perspective on state-of-the-art research on self-regulated learning. *Instructional Science*, *33*(5/6), 559-565. https://doi.org/10.1007/s11251-005-1280-9

Winne, P. H. (2010). Improving measurement of self-regulated learning. *Educational Psychologist*, *45*(4), 267-276. https://doi.org/10.1080/00461520.2010.517150

Wong, J., Baars, M., Davis, D., Van Der Zee, T., Houben, G. J., & Paas, F. (2019). Supporting self-regulated learning in online learning environments and MOOCs: A systematic review. *International Journal of Human–Computer Interaction*, *35*(4-5), 356-373. https://doi.org/10.1080/10447318.2018.1543084

Yang, X., & You, Y. (2018). How the world-class university project affects scientific productivity? Evidence from a survey of faculty members in China. *Higher Education Policy*, *31*(4), 583-605. https://doi.org/10.1057/s41307-017-0073-5

Zhang, R., Cheng, G., & Chen, X. (2020). Game-based self-regulated language learning: Theoretical analysis and bibliometrics. *PLoS ONE*, *15*(12), 1-14. https://doi.org/10.1371/journal.pone.0243827

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: An overview. *Educational Psychologist*, *25*(1), 3-17. https://doi.org/10.1207/s15326985ep2501_2

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice*, *41*(2), 64-70. https://doi.org/10.1207/s15430421tip4102_2

Journal of Theoretical Educational Science, 16(3), 727-748, July 2023
Kuramsal Eğitimbilim Dergisi, 16(3), 727-748, Temmuz 2023
[Online]: http://dergipark.org.tr/akukeg
DOI number: http://doi.org/10.30831/akukeg.1231166

A Day at the Science Center: Examining the Experience of the Pre-Service Elementary Teachers on the Practices at the Science Center

Bilim Merkezinde Bir Gün: Sınıf Öğretmeni Adaylarının Bilim Merkezindeki Uygulamalara İlişkin Deneyimlerinin İncelenmesi

Sema AYDIN CERAN* **Seher ESEN****

Received: 8 January 2023 **Research Article** **Accepted:** 19 July 2023

ABSTRACT: This research was carried out to reveal the experiences of pre-service elementary teachers during their visit to the science center and their observations and opinions about this experience. For this purpose, a case study, which is one of the qualitative research designs, was adopted. 32 pre-service elementary teachers participated in the research. Interviews, observations, and diaries were used to obtain the data, and the data were subjected to content analysis. As a result of the analysis, four themes were reached: image, interest, contribution, and improvement. The results show that pre-service teachers associate the science center image they create with technology, laboratory, and scientists. It was determined that pre-service teachers showed more interest in some disciplines of science, scientists, and technology-related fields in the science center. In addition, it was concluded that the science center would contribute to the innovative and productive vision, economy, and science literacy of the society in the city where it is located, science teaching, and the professional development of teachers. Finally, the pre-service teachers made suggestions to increase the contribution of science centers to the region and society. The results of this study are expected to be a valuable guide, providing science teaching experience and a qualified science teaching vision for pre-service elementary teachers in informal environments.

Keywords: Pre-service elementary teacher training, science education for pre-service elementary teacher, Out-of-school learning environments, science center.

ÖZ: Bu araştırma, sınıf öğretmeni adaylarının bilim merkezi ziyaretinde edindikleri deneyimleri ve bu deneyime ilişkin gözlem ve görüşlerini ortaya çıkarmak amacıyla gerçekleştirilmiştir. Bu amaç doğrultusunda nitel araştırma desenlerinden biri olan durum çalışması benimsenmiştir. Araştırmaya 32 sınıf öğretmeni adayı katılmıştır. Verilere ulaşmak için görüşme, gözlem formu ve günlükler kullanılmıştır. Elde edilen veriler içerik analizi yöntemi ile analiz edilmiştir. Analiz sonucunda; imaj, ilgi, katkı ve iyileştirme şeklinde dört temaya ulaşılmıştır. Sonuçlar öğretmen adaylarının oluşturdukları bilim merkezi imajını teknoloji, laboratuvar/deney odaklı mekân ve bilim insanlarıyla ilişkilendirdiklerini göstermektedir. Öğretmen adaylarının bilim merkezinde bazı bilim dallarına, bilim insanlarına ve teknoloji içerikli alanlara daha fazla ilgi gösterdikleri saptanmıştır. Ayrıca bilim merkezlerinin bulunduğu şehrin yenilikçi ve üretken vizyonuna, ekonomisine, toplumun bilim okuryazarlığına, bilim öğretimine ve öğretmenlerin mesleki gelişimlerine katkı sunacağına ilişkin sonuçlara ulaşılmıştır. Son olarak öğretmen adayları, bilim merkezlerinin bölgeye ve topluma katkılarının artırılması için önerilerde bulunmuşlardır. Sonuçların informal ortamlarda sınıf öğretmeni adaylarına bilim öğretimi deneyimi ve nitelikli fen öğretimi vizyonu kazandırılması bakımından yol gösterici olacağı düşünülmektedir.

Anahtar kelimeler: Sınıf öğretmeni yetiştirme, sınıf öğretmeni adayları için fen eğitimi, okul dışı öğrenme ortamları bilim merkezi.

* *Corresponding Author*: Asst. Prof. Dr., Selcuk University, Konya, Türkiye, sema.aydinceran@selcuk.edu.tr, https://orcid.org/0000-0001-6847-2766
** Research Assistant, Selcuk University, Konya, Türkiye, sesen@selcuk.edu.tr, https://orcid.org/0000-0002-3569-1185

Citation Information
Aydın Ceran, S., & Esen, S. (2023). A day at the science center: examining the experience of the pre-service elementary teachers on the practices at the science center. *Kuramsal Eğitimbilim Dergisi [Journal of Theoretical Educational Science], 16*(3), ???-???.

ISSN: 1308-1659

Learning is a formal and informal process that continues throughout the life outside of school (Laçin-Şimşek & Öztürk, 2021). Contrary to the formal education provided in the school system with traditional methods, learning in informal and out-of-school learning environments is more effective and motivating (Salmi, 1993; Selanik-Ay & Erbasan, 2016). Out-of-school learning is implemented during the school term and according to the curriculum, but takes place in environments and institutions outside the school building. This shows that out-of-school learning, which seems to be a part of informal education, is also related to formal education (Salmi, 1993). The steps taken to support learning in out-of-school learning environments in parallel with the curriculum can also contribute to science education because out-of-school teaching and learning help students understand science in a more contextual and holistic way compared to classroom learning (Rodéhn, 2019). Out-of-school learning environments such as museums, zoos, libraries, open-air museums, and aquariums support formal education environments. One of the most important of these out-of-school learning environments is science centers (Bell et al., 2009; Şentürk & Özdemir, 2014). Science centers, which started to serve in the 1960s, aim to popularize science among the general public (Yıldız Kuyrukçu, 2018) and present scientific information to their visitors in an entertaining and interesting way (Laçin-Şimşek & Öztürk, 2021; Weitze, 2003). Shein et al. (2019) stated that visits to science centers contribute to the knowledge, understanding, participation, and interest in science and technology in the general public. In other words, the aim of science centers that appeal to large masses is to contribute to the development of scientific literacy and the discovery of the mysteries of science throughout science education (Medved & Oatley, 2000). In science centers, emotional and interactive sensory experiences are accompanied by specific informational and cognitive goals (NRC, 2009).

To make children's science learning effective, teachers should enrich the teaching process with out-of-school learning environments such as science centers (Tasdemir et al., 2014). Science centers, with a large target audience of school-age children (Kisiel, 2006), enrich students' science learning processes and offer an inquiry and research-based learning opportunity (Phillips et al., 2007). These centers increase interest and curiosity in science and technology and make science and technology an important topic in society (Bozdoğan, 2008). Interactive and interesting activities within science centers are complementary environments for science education (Koyuncu & Kırgız, 2016; Rennie, 2007). Considering the studies conducted with students in science centers, it is found that science center experiences improve knowledge, skills, and attitudes towards science, provide a relationship between real life and what is learned at school, and provide a scientific perspective on daily events (Laçin Şimşek, 2011; Kırgız, 2018). However, although out-of-school learning experiences offer beneficial results for students, they may not suffice on their own. In such out-of-school environments, teachers can take on different roles to make learning more effective. While some teachers take on more passive roles, others may act like a maestro to organize students' experiences (Şentürk, 2015). In these trips, the teacher's interaction with the students, process planning, and their knowledge of the field and learning styles affect the learning process (Tran, 2011). Krange et al. (2020) reported that students had difficulty in trying to make sense of scientific concepts during the trip, and groups supported by teachers and guides made sense of these concepts more easily. Elementary

teachers' perceptions, which largely mediate the effectiveness of science teaching in enriched out-of-school learning environments, will affect their interest and participation in enriching curriculum resources (Luehmann & Markowitz, 2007). Although the target audience during the trip is students, these learning experiences are shaped by teachers (Kisiel, 2006). For this reason, teachers' experiences, attitudes, and perspectives towards science centers will also help them plan and conduct science center trips in parallel with the curriculum. In addition, teachers must have sufficient pedagogical content knowledge in order for out-of-school science activities carried out outside the school context to be successful (Geveke et al., 2017). Dewitt and Hohenstein (2010) argue that the effectiveness of such school trips depends on teacher-student interactions both during, before, and after the trip. In addition to the students' experiences during the science center trip, the teacher's plan, practices, and activities to reinforce the learning after the visit also encourage effective learning (Köseoğlu et al., 2020). On the contrary, in the study conducted by Morentin and Guisasola (2015), most of the teachers who visited the science center with their students reported that they made almost no preparation for the visit.

Therefore, teachers need to be equipped with the knowledge and skills they feel sufficient to activate all learning environments inside and outside the school. In this respect, the importance of furnishing prospective teachers with sufficient equipment and knowledge becomes evident. It is suggested that teacher candidates feel anxiety and insecurity about science education, and therefore, studies on different applications in science education can provide valuable guidance for educators and researchers (Steele et al., 2013). It has been reported that elementary teacher candidates have low self-efficacy (Kazempour & Sadler, 2015; Mintzes et al., 2013). Palmer (2006) emphasizes that this low self-efficacy may negatively affect prospective science teachers' future science teaching. For this reason, it is considered important for pre-service teachers to have experiences in which they can be successful in science education and to feel competent in this regard (Carrier, 2009). This outcome reveals the importance of studies with elementary teacher candidates in the context of science education. Studies show that different experiences in science education shape pre-service teachers' beliefs and approaches to science and science education (Bleicher, 2007; Carrier et al., 2017; Mintzes et al., 2013). In addition, Tasdemir et al. (2014) reported that pre-service elementary 'teachers' visits to science centers were effective in developing positive attitudes towards science centers and science courses. Eren-Sisman et al. (2020) stated that science teacher candidates' visits to science centers positively changed their views on the nature of science.

Within the framework of this research, it is important to reveal the experiences of the prospective elementary teachers about the science center and their thoughts on these experiences. For this purpose, a science center trip was organized in which first-year students were included in the study. The aim of this study was to examine the experiences of pre-service elementary teachers during the trip and gather their observations and opinions about this experience after the trip. In this context, it is anticipated that the research will make a valuable contribution to the literature by providing pre-service elementary teachers with science teaching experience in informal environments.

Method

Research Model

Qualitative research method was used in the research. Qualitative research method allows more in-depth information to discover subjects about which the information is scarce (Creswell, 2020). This research was conducted as a case study, one of the qualitative research designs and a research approach that emphasizes understanding, defining, predicting, or controlling an individual, group, or cultural situation (Akar, 2016). In case studies, which allow one or more phenomenon to be investigated in depth, factors related to the phenomenon (environment, individuals, events, processes, etc.) are investigated with a holistic approach by focusing on how they affect the relevant situation and also how they are affected by the relevant situation (Yıldırım & Şimşek, 2021). In case studies planned based on experience, each researcher has a unique approach to determining their own process (Akar, 2016). In this context, the research was carried out with a case study pattern to describe the first-year pre-service elementary 'teachers' visits to the science center and their experiences related to these visits.

Study Group

The study group of the research consists of first-year students studying in the Elementary Education Department at a university in Türkiye. The study group of this qualitative research was determined using the purposive sampling method. The logic and power of purposive sampling, which allows for an in-depth study, lies in the selection of information-rich situations (Patton, 2018). In this study, an easily accessible case sampling method, which is one of the purposeful sampling methods, was used in terms of practicality and convenience. This sampling method is generally used when the researcher does not have the opportunity to use other sampling methods (Yıldırım & Şimşek, 2021). The sample group of this study consists of 32 pre-service teachers, 22 females, and 10 males, who were studying at the faculty of education, where the researchers were teaching and participating voluntarily due to easy accessibility. 20 of the pre-service teachers stated that they had never been to a science center before. However, six pre-service teachers stated that they visited the science center during their secondary school or high school periods, and six of them when they came to the university for enrollment.

Data Collection Tools

In case studies, it is generally recommended to reach a richer data diversity using more than one data source to provide an in-depth perspective on the subject (Creswell, 2019; Yıldırım & Şimşek, 2021). Therefore, this research aimed to obtain rich data using interviews, observations, and diaries. The semi-structured interview form, an observation form, and a diary form, which were prepared by taking the opinions of the researchers, were used to collect data in the research.

Observation Form

An observation form was developed by two researchers to observe the experiences of the students in the science center. A field expert in science examined this observation form. Thus, the observation form, which was adapted in line with the

opinions of the field expert, aims to present the students' experiences during their visit to the science center from the researchers' point of view. The observation form consists of individual and group observations: "How were the students' reactions? Which exhibits were they most interested in? Which gallery received the most attention? How were the workshops? Observations about the planetarium; observations about free time; the status of active-passive participants; interaction of students with each other; interactions of students with their mentors and other teachers; the 'guides' content knowledge proficiency levels; physical capacity of exhibits in the science center and technical problems."

My Science Center Trip Diary

A form titled "My Science Center Trip Diary" was prepared by the researchers to allow pre-service teachers to express their ideas about the science center visit from their perspective. The observation form and "My Science Center Trip Diary" focus on pre-service teachers' experiences during their visit to the science center. In the travel diary, certain reference points were added so that the prospective teachers do not deviate from the context. A few of these references are: "My thoughts on the location, physical appearance, and transportation of the Science Center; what I saw/ learned in the gallery I visited; what did I see/learned in the workshop?" In addition, an open-ended section was added to the trip diary about other issues that pre-service teachers wanted to add.

Interview form

After the science center visits, a semi-structured interview form was used to evaluate the pre-service teachers' perceptions towards science centers. There are 13 questions in the semi-structured interview form, such as "What kind of contributions can the galleries, experiment sets, and activities in the science center have on science teaching? As a pre-service teacher, how can the galleries, experiment sets, and activities in the science center affect the future lives of primary school students? What kind of contributions do you think science centers will make to your professional development?" In addition, drilling questions such as the following were included in order to obtain more detailed information: "How do the galleries, exhibits, and activities in the science center relate to the field-specific skills (scientific process skills, life skills, engineering design skills) in elementary level teaching of science? Can you evaluate it?". To analyze the data related to the semi-structured interview form in more depth, face-to-face interviews were conducted with five students who filled out the form. The interviews were recorded with the consent of the participants, and then the recordings were transcribed.

Data Analysis

The data were analyzed by an inductive analysis method. The main purpose of the inductive analysis is to reach concepts and relationships that can explain the collected data. For this purpose, the obtained data are first conceptualized by subjecting them to a deep process, then the themes and patterns that explain the data are obtained by organizing them logically according to the emerging concepts (Yıldırım & Şimşek, 2021). The data obtained in this research were transcribed in detail and transferred to electronic media. The entries were read by two researchers separately, and more than once, and notes were taken next to the answers given by the pre-service teachers.

Possible codes in this process were determined separately by both researchers. At this stage, all the answers given by the pre-service teachers to a question in the interview form, the diary covering a situation and all the observation statements were taken into consideration. In creating codes, both researchers created coding schemes for the interview, observation, and diary. The codes identified were compared, and a consensus was reached in 27 of the 30 codes presented under each category within the findings (90%). For example, it was observed that the researchers had different codes, such as "science in a fan" and "science tube" for the question "How were the reactions of the pre-service teachers?" in the observation form. Afterwards, a common opinion was reached using the code "scientific fan" for this situation. A new evaluation was made on situations differing in terms of reasons and perspectives. As a result of this evaluation, new codes were created for situations reflecting a different opinion. From this point of view, appropriate codes, categories, and themes were reached. A detailed content analysis was carried out by determining the percentages of codes and categories obtained. A different field expert monitored the whole code and category creation process, and their opinion was taken in case of dilemmas. Thus, the final data classification was completed. Correlation value for the inter-research agreement was examined. The themes, categories, and codes generated from the coding schemes were presented in a summary table by adopting the principle of presentation of findings at a glance (Saldana, 2019).

Credibility and Ethical Procedures

The quality and credibility of qualitative research refer to the transparency of the entire research process, the processes related to the verification of findings and results, and the credibility of the truth of the findings (Agar et al., 2004; Lincoln & Guba, 1985). Some steps were taken to increase credibility in the research process. To give valid and reliable results from the data collection tools used in the research, experimental and theoretical publications made with pre-service science teachers, in-service teachers, and primary/secondary school students were reviewed, and the results of national and international education indicators on informal learning environments were examined (World Economic Forum [WEF], 2020; Organization for Economic Co-operation and Development [OECD], 2019). In addition, the opinions of field experts were taken. Thus, the research questions were created by comparing the relevant literature, expert opinions, and the objectives of the Ministry of National Education Science Curriculum (MEB, 2018). A pilot study of the data collection tool was made, and the data collection tools were finalized.

It is recommended to use multiple validity methods to evaluate the accuracy of interpretations in studies (Creswell, 2019). Glesne (2020) suggested some methods to ensure credibility in qualitative research. Another important step taken in ensuring the credibility of this research is the use of multiple data collection tools (triangulation). In order to diversify the data collection methods, interview, observation, and document analysis methods were used together. When observation, interview, and document analysis methods are used together in qualitative research, it significantly increases the validity of the research by serving the purpose of "data triangulation" (Yıldırım & Şimşek, 2021). In addition, methods such as receiving the opinions of field experts

(colleague evaluation) and confirming the participants' opinions (participant approval) were applied in the research.

Cross-checks are very important when analyzing qualitative research data (Denzin & Lincoln, 2011). For this, the results of the analysis were compared and discussed by the researchers. In addition, the results obtained are explained with examples to increase credibility (Arastaman et al., 2018). Thus, code-category and themes are supported by direct quotations. Another dimension related to ensuring the reliability of the research is the compatibility of the coders with each other. In terms of the reliability of the research, more than one researcher should review each lists together after coding the data separately (Miles & Huberman, 2019). To this end, two researchers came together frequently to achieve consensus between the codes, categories, and themes they created and completed the coding, theming, and conceptualization processes. For this study, the percentage of agreement among the coders was calculated (90%). The data with disagreement were re-examined and re-coded, and a consensus was achieved. The voluntary participation statement form was sent to all teacher candidates participating in the research in an electronic environment, and their approvals were obtained. Data from participants who had a voluntary participation declaration were used only. In accordance with the ethical principles of the research, these people were given codes as "PSET1" (indicating the first participant who is a pre-service elementary teacher). In addition, official permission was obtained for this research by the Scientific Ethics Evaluation Committee of the Faculty of Education of Selcuk University (#E-16343714-605.02-316109, Date: 02/07/2022).

Results

In this section, the findings obtained as a result of the analysis of the data obtained from different data sources such as interviews, observations, and diaries to reveal the experiences, observations, and opinions of the pre-service elementary teachers about the practices in the science center are included. In the presentation of the findings, it was aimed at protecting the integrity of the study. For this reason, the pattern consisting of themes, categories, and codes is presented in line with the principle of "representation of findings at a glance" (Saldana, 2019) to give the reader a clear perspective. Because important points may be overlooked when embedded in explanations, the codes or categories reached can be highlighted by using simple tables and figures, rich text features, headings, and subheadings so that the reader can see them at a single glance (Saldana, 2019, p.285). A summary of the study findings obtained from the research data is presented in Table 1.

As shown in Table 1, 4 themes, 10 categories, and 30 codes were obtained in the analysis of the data obtained from the interviews, observations, and diaries involving 32 pre-service teachers. To preserve the integrity of the study, the findings are presented with sample expressions in the text, without separating the data sources, instead of showing the codes and percentages in the table (Çavuş-Güngören & Hamzaoğlu, 2020).

Table 1

Summary of Study Findings on the Experiences of Pre-Service Elementary Teachers in the Process of Their Science Center Visits

Theme	Category	Code
Image	Spatial Image	Technology
		Scientific showcase
		Simulation
		Scientific Experiments
		Laboratory
		Astronomy
	Scientist Image	Invention and Discovery
		Scientists in the age they lived
		Scientific Development
Interest	Sciences	
		Geology
		Climatology
		Astronomy
		Biology
	Scientists	Turkish-Islamic Scientists
		Inventions
	Technology	Technology from the Past to the Present
Contribution	Contribution of the Science Center to the City Where It Is Located	Contribution to the Innovative and Manufacturing Vision of the City
		Contribution to the Economy of the City
		Contribution to Development of Scientific Literacy of People in the City
	Contribution to Science Teaching	Supporting Science Teaching for Primary School Students
		Enriching a Vision of Science Teaching in Teacher Training
		Opportunity for Children and Parents to Learn Science Together
	Contribution to Professional Development	Providing Experience for Out-of-School Learning Environments
		Supporting Domain Knowledge
Improvement	Improvement Ideas	Location of Science Center
		Number of Science Centers
		Community Access of Science Centers
	Renovation Works	Necessity of Repairing Non-Working Experiment Sets
		The Need for Presenting New Inventions and Developments

Image

In the study, in which the experiences, observations, and opinions of the pre-service teachers regarding the practices in the science center were examined, it was observed that the pre-service teachers developed an image for the science center. Under the image theme, there are two categories: "Spatial Image" and "Scientist Image".

In the Spatial Image category, the pre-service teachers developed an image that focuses on the physical features of the science center. They matched the spatial image of the science center with Technology (47%), Laboratory (45%), Scientific Experiments (44%), Astronomy (38%), Scientific showcase (11%), and Simulation (10%). Based on the science center observations and experiences of the pre-service teachers, it was observed that they created a spatial image for the science center that is focused on technology, laboratory, and experiment. Some of the opinions obtained from the interviews and diaries of the prospective teachers regarding the Spatial Image category are as follows:

> An area where many technologies and technological inventions take place (PSET1).
>
> Sections with interesting materials that bring science and technology together. Experiment rooms with elements that are unlikely to be encountered. Innovative sections that go in parallel with new inventions. Simulation rooms which allow us to experience (PSET7).
>
> The science center is like a scientific showcase with laboratory environments and experimental materials (PSET28).
>
> When I first entered, it was very impressive and large. The first thing that caught my attention was the robot I saw on the giant screen. A huge technologically advanced space consisting of many galleries… (PSET30, Diary).

In the Scientist Image category, it was determined that the pre-service teachers identified their image of the science center with the scientist. Under this category, two different codes are seen: Inventions and Discoveries of Scientists (78%) and Scientists in the Age They Lived (65%). Pre-service teachers identified the science center with the inventions that emerged as a result of the efforts of scientists specific to the period in which they lived. Some of the opinions obtained from the interviews and diaries regarding this category are as follows:

> It is a huge room where the inventions that emerged in the fields of physics, chemistry, and biology from the past to the present and the scientists who made these discoveries (PSET18).
>
> A field full of scientists and inventions (PSET22).
>
> When I first entered, I was very impressed by the reflection of Hezarfen Ahmet Çelebi on the screen, and it made me feel like I was in a science center (PSET32, Diary).

Interest

Pre-service elementary teachers showed interest in different galleries or sections in the science center. In the construction of the theme of interest, pre-service teachers' "feeling closeness to, liking, or prioritizing a certain event, activity, or person" was taken into consideration. There are three categories under the theme of interest: Scientific Disciplines, Scientists, and Technology. It was observed that the pre-service elementary teachers, who saw many different galleries, activities, or workshops in the science center, concentrated more on some particular areas. These activities or applications are explained in detail in the codes under categories.

In the category of "Scientific Disciplines", pre-service teachers preferred galleries, activities, or workshops regarding Geology (56%), Climatology (54%),

Astronomy (49%), and Biology (47%). To this end, it was determined that pre-service teachers showed more interest in the sections of Earthquake Simulations, Natural Disasters, Climate Studies, Climate Capsules, Solar System, Galaxies, Space, Stars, Human Body/Systems, and Harms of Smoking. However, very few teacher candidates visited the mechanics gallery in their free time. Some of the samples from the interviews, diary entries, and participant observations related to this category are given below:

> …AFAD was a place that provided experience. We were able to experience natural events such as storms and earthquakes. I simulated natural events such as tsunamis, tornadoes, floods, and avalanches. The climate rooms were also very nice. Maybe I felt the air temperatures that I could never feel. I was very interested in examining the structures in our bodies in more detail (PSET8).
>
> …one of the applications that I liked the most was the part where we examined our fingers and the structure of our t-shirt with a microscope (PSET10).
>
> I was excited to see the systems in our body and their functioning in detail... Also, the three-dimensional movie we watched, traveling in Space, was amazing… It helped me realize once again how magnificent and orderly the space is (PSET13, Diary).
>
> …In general, they had a more enjoyable time in "our body" gallery. The female students showed interest in the experimental sets related to respiration and cell subjects and listened to the guide more carefully… (Participant Observer 2)

Another area of interest for pre-service elementary teachers during their science center trips was ""Scientists". There are two different codes in the "Scientists" category, namely, Turkish-Islamic Scientists (77%) and Inventions of Scientists (68%). Pre-service teachers showed a great interest in scientists and their contributions to society at the science center. Participant observer notes and findings from the interviews point out that pre-service teachers were interested and excited about Turkish-Islamic Scientists because they did not have enough knowledge about this field before. Some opinions from interviews, diary entries, and participant observation notes regarding this category are given below:

> I studied Turkish-Islamic scholars and their inventions in the free section. I didn't know before that our own ancestors had such important work (PSET8).
>
> The area where the works of Muslim scientists were exhibited was the one that was most interesting to me. It was enjoyable to examine the models that showed the working mechanism of the inventions there (PSET9)
>
> The discoveries of scientists were very interesting. The structures were complex and different in mindset. For example, I found Al Jazari's lock system very interesting and successful (PSET27, Diary)
>
> It was observed that the teacher candidates showed great interest in the Sultans of Science Gallery. During this period, the pre-service teachers told each other and the advisor faculty member that they had never heard of this information about scientists before and did not know. In addition, it was observed that they were surprised next to the sets in which some scientists-inventions took place (Participant Observer 1).

Another category under the theme of interest is "Technology". Two different codes are listed under this category: Technology from Past to Present (69%) and Robots (56%). Pre-service teachers showed a great interest in the technological departments or galleries in the science center both in guided field trips and in their free time. Findings from interviews, diaries, and observation notes indicate that male pre-service teachers showed more interest in technology-related fields. Some opinions regarding this category are given below:

> It was the robot upstairs that caught my attention the most. It was mimicking your moves. Future uses for robots were inspiring (PSET15)
>
> It was very interesting to observe the scientific progress from the inventions made in the past centuries to the developments in the current century (PSET26, Diary)
>
> …It was observed that male pre-service teachers wanted to spend more time in the galleries visited, especially in technological tools, engineering, and design mechanisms (Participant Observer 2)

Contribution

In the study, it was observed that the pre-service teachers also focused on the contributions of the science center. There are three different categories under the theme of contribution: "Contribution to the City where the Science Center is Located," "Contribution to Science Teaching," and "Contribution to Professional Development."

Pre-service teachers evaluated "Contribution of the Science Center to the City Where It Is Located" based on their experiences of visiting the science center. Under this category, there are three different codes: Supporting the City's Innovative and Manufacturer Vision (68%), Supporting the City's Economy (62%), and Developing the City's Science Literacy (56%). Based on the experience they gained, the pre-service elementary teachers gained an awareness that the science center can contribute to the city where it is located. They interpreted this contribution in terms of the students living in the city, the people of the city, and the city's economy and innovative vision. Some opinions from interviews, diaries, and participant observation notes regarding this category are given below:

> I think that if the people in the region can take full advantage of it, it will significantly improve the science literacy of the people there and promote science (PSET10).
>
> I think it attracts students or individuals interested in science not only in the city where it is located but also in the whole region, and thus increases the interest in science. I also believe that this will contribute to the economic development of the city (PSET30).
>
> Such a place undoubtedly gives the region the feature of being an area frequented by visitors. It supports the city's work in science and technology. It makes the city more productive and innovative (PSET6, Diary).

Another category discussed under the contribution theme is the science center's contribution to Science Teaching. In this category, there are three different codes: "Supporting Science Teaching for Elementary Students (69%)", "Providing Science Teaching Vision in Teacher Training (67%)", and "Children's and Parents' Opportunity to Learn Science Together (55%)". Pre-service elementary teachers interpret the contribution of the science center to science teaching in terms of students, teachers, and parents. Pre-service elementary teachers are of the opinion that science centers will contribute to increasing the interest and passion of especially primary school children in science, supporting permanent learning, and increasing science achievement. In addition, they see the science center as an important element in training elementary teachers and supporting teacher candidates' science teaching competencies. In addition, pre-service teachers think that the science center is important for the child to learn and experience science with their parents. Some of the opinions obtained from the interviews and diaries regarding this category are given below:

> In theory, everyone knows about science more or less. However, learning by observing and understanding by discovering makes learning science more permanent and enjoyable. I think that the science center will bring this perspective to teachers in science teaching (PSET1)

> Undoubtedly, children are more willing and creative than us in imagination and discovery. It will contribute much more to their creativity and learning if they see these features by trying and living in the science center instead of just learning them as theory. I think it will also support children to develop permanent skills in their future lives (PSET12)
>
> Today I saw children visiting the science center with their parents. It's nice that the science center offers the opportunity to learn science together for both parents and children. I think it will have positive effects if the school encourages families to visit the science center (PSET20, Diary).

Another category discussed in the context of the contribution theme is "Contribution to Professional Development". Pre-service elementary teachers emphasized the contribution of the science center to the professional development of in-service and pre-service teachers in line with their experiences in the science center. This emphasis is mostly on Gaining Experience (78%) and Supporting Field Knowledge (68%) for out-of-school learning environments. Pre-service elementary teachers see science centers as an effective out-of-school learning environment for science teaching. In addition, they see it as an opportunity, especially for schools that do not have laboratories or teaching materials. Another point that the pre-service elementary teachers find important in contributing to professional development is that the science center is an important component supporting the subject knowledge. Pre-service teachers believe that the experiments, activities, and practices in the science center will support the current and basic subject knowledge required for science teaching. Some opinions regarding this category are given below:

> When I become a teacher, I would like to take my students to the science center often because it is easier for them to understand something they see with their eyes and try. It also gives me an important experience outside the classroom as a teacher (PSET17).
>
> Since my students will be more inclined to be influenced by what they see and have more fun because of their young age, the science center will keep their minds active and offer them the opportunity to have a pleasant time. For this reason, I would like to take my students to places such as science centers whenever possible (PSET18).
>
> I think that science centers will provide an important awareness for science teachers. The teacher can realize their productive, curious, questioning, and observant characteristics, learn new information, complete missing information, and come up with new project ideas (PSET22).

Improvement

Another prominent theme within the scope of the study is "Improvement". Within the scope of this theme, the pre-service elementary teachers mentioned "Improvement Ideas" and improvements to be done in order for the science center to operate more effectively, based on their experiences.

In the category of "Improvement", there are three different codes: Location of the Science Center (72%), Number of Science Centers (58%), and Accessibility of Science Centers by the Community (51%). Pre-service teachers stated that science centers should be located closer to the city to increase the science literacy of society, reach more students, and be beneficial for all segments of society. They also stated that the number of science centers should be increased or research centers or workshops affiliated with the science center should be established in different parts of the city. Finally, they mentioned that the science center should be supported with activities that

provide access to the community. Some of the opinions obtained from the interviews, diaries, and participant observer notes are given below:

> It would be better if the location of the science center was accessible to everyone. It is very difficult to reach here from many parts of the city (PSET3, Diary).
>
> …exhibitions, galleries, and seminars on different subjects can be opened every month. People can benefit from these activities by announcing all segments of society through advertisements (PSET12).
>
> Children and teachers should be encouraged to visit this place frequently and benefit from different activities. For example, for me, it was a day worth getting up at 6 in the morning and walking for half an hour and traveling by tram for half an hour (PSET9).
>
> …the conversations with the pre-service teachers in front of the science center in the early morning hours were related to the fact that the science center was so distant. Some students had come by transferring three different vehicles. Some were even late. However, although the science center was distant, it impressed and excited them with its external appearance. At the end of the science center tour, the conversations between them were like "everyone should benefit from it", "When I become a teacher, I would definitely bring my students"... (Participant Observer 1)

Another category in the improvement theme is "Renovation Works". In this category, the codes "the Need for Repairing Non-Working Exhibits (73%)" and "To Include New Inventions/Innovations and Developments (56%)" were included. Based on their experiences, the pre-service teachers mentioned that the exhibitions that did not work in the science center should be repaired, and some closed galleries should be opened. In addition, they made suggestions for the addition of new galleries, inventions and innovations in light of the current scientific developments in order for the science center to operate more effectively. Some of the opinions obtained from the interviews, diaries, and participant observer notes regarding this category are given below:

> New galleries may be opened over the years, or new research and events may be added to existing galleries. New scientists and their studies can be added. Events for that day can be organized on certain special days (PSET16).
>
> I think non-working instruments and test sets should be repaired. My second visit here, and the same test exhibits were not working (PSET24, Diary).
>
> …the pre-service teachers asked questions of the lecturers and guides that some of the exhibits did not work. In addition, it was observed that some teacher candidates directed their criticisms to the guides about the fact that they could not see the work of some Turkish scientists, such as Canan Dağdeviren and Mete Atatüre (Participant Observer 2).

Discussion and Conclusion

The study aimed to examine the experiences of pre-service elementary teachers during the Konya Science Center trip and their observations and opinions about this experience after the trip, and the results are discussed in the context of "image"," "interest"," "contribution," and "improvement" themes.

In the study, it was determined that the pre-service elementary teachers developed an image for the science center. This image focused on the spatial characteristics of the science center and scientists. Science center images of teacher candidates focusing on space are mostly related to technology, laboratories, and scientific experiments. Sayar and Arat (2017) define Konya Science Center as a building that has the feature of being a symbol building for Türkiye and Konya City with its design considering many criteria in detail and because it is a Leeds-certified sustainable building. Colors and lighting used in the design of the spaces in Konya

Science Center impress the visitors, especially children (Burkut, 2018). In this study, pre-service teachers found the interior and exterior design of the science center quite technological and were affected by this design. Furthermore, the identification of the science center with the spatial image dimension with laboratories, scientific experiments, astronomy, scientific showcase, and simulations is an original result. In addition, another image developed for the science center is the scientists' dimension. Based on the observations they obtained during the science center trip, the pre-service teachers identified the science center with the inventions that emerged as a result of the studies of scientists specific to the period in which they lived. Considering the limited number of studies in the related literature on how pre-service teachers perceive science centers or how they create an image related to science centers, the results of this study are new in the field in terms of the images developed for the science center.

It was determined that the pre-service teachers showed interest in different galleries or sections during the science center trip. This interest stands out with scientific disciplines, scientists, and technology. In terms of scientific disciplines, it was observed that pre-service teachers preferred the following galleries, activities, or applications that represent Geology, Climatology, Astronomy and Biology: Earthquake Simulation, Natural Disasters, Climate Studies, Solar System, Galaxies, Space, Stars, and Human Body/Systems. However, it was determined that very few teacher candidates visited the mechanics gallery in their free time. Studies have shown that students have problems at the conceptual level in the mechanics-related subjects of physics, that these subjects are difficult and boring for the students, and that they have difficulties in practice in daily life (Eryılmaz & Tatlı, 2000; Gülçiçek & Yağbasan, 2004; Lye et al., 2002; Yeltekin-Atar et al., 2021). There may be different reasons why prospective elementary teachers, who see many different galleries, activities, or workshops in the science center, show more interest in some areas. As a matter of fact, the pre-service elementary teachers participating in the research were in the second term of their undergraduate education. They take Basic Science and Environmental Education in Elementary School courses. The subject areas they learned within the scope of these courses and the galleries, activities, and practices they were interested in at the science center were similar. This situation may have caused the pre-service teachers to turn to and be interested in practices that provide evidence about the subjects they know theoretically. Similarly, in their research with teachers, Yolcu and Karamustafaoğlu (2021) determined that elementary teachers, unlike science teachers, talked about topics that can be matched with the topics in life studies and social studies courses in addition to the science course in the virtual science center trip. The reason for this situation is explained by the fact that elementary teachers receive training for different courses. Another area of interest for pre-service teachers during their visit to the science center was "Turkish-Islamic Scientists" and "Inventions of Scientists". The reason why the pre-service teachers were interested and excited about Turkish-Islamic Scientists may be due to the fact that they did not have enough knowledge about scientists, research processes, and inventions of scientists. Studies have shown that the perceptions and knowledge of pre-service elementary teachers about scientists include stereotypes and are not based on a realistic basis (Çermik, 2013; Oğuz-Ünver, 2010). The research results indicate that adequate educational support should be provided not only in terms of the perception of scientists but also in terms of having knowledge about

scientists. Finally, another area that teacher candidates are interested in in the science center is the technology dimension. In the study, it was observed that especially male pre-service teachers showed more interest in technology galleries, which also include robots, in the science center. When review studies in the field are examined, studies show that male pre-service teachers' attitudes and competencies towards technology were higher than those of female pre-service teachers (Aksoğan & Bulut Özek, 2020; Arslan et al., 2011; Çetin et al., 2012; Kubiatko et al., 2010; Özdemir & Taç, 2017; Sainz & López-Sáez, 2010). This result indicates that measures should be taken to positively support female pre-service elementary teachers' interests and attitudes towards technology.

It was concluded that the pre-service elementary teachers made inferences about the contributions of the science center based on their experiences in the science center. The results obtained in the context of contribution can be considered in three different dimensions: its contribution to the city where the science center is located, its contribution to science teaching, and its contribution to professional development. In line with their experiences, pre-service teachers interpreted its contribution to the city where it is located in terms of supporting the city's innovative and manufacturing vision and economy and improving the city's science literacy. Shein et al. (2019) stated that visits to science centers contribute to the public's knowledge, understanding, participation, and interest in science and technology. Görkemli and Solmaz (2012), who discussed what the Science Center could add to Konya in their study, stated that science centers would attract more visitors and investors to the city, will be an important center of attraction in the city, and these effects will contribute to the city's economy and development. According to Tlili et al. (2006), these centers establish a link between science, education, and industry. The elementary teachers' ideas about the science center's contribution to the city where it is located are considered as an important result of the study. This evaluation sheds light on how they perceive science centers as centers of attraction for science teaching in their professional lives. According to another result in the context of contribution, pre-service teachers believe the science center contributes to science teaching. It was concluded that they interpreted this contribution as supporting science teaching for primary school students, providing a vision of science teaching in teacher training, and providing the child with the opportunity to learn science with their parents. Studies with students have shown that science center trips increase children's desire to be a scientist and do scientific research, improve success in science courses, create a desire to choose professions in the field of science and technology and provide a better understanding of scientific concepts (Dohn, 2013; Erçetin & Görgülü, 2018; Guisasola et al., 2005; Ok & Aslan, 2020; Ross et al., 2010). The research showed that the science center supports science teaching, which is similar to the results of studies conducted with in-service and pre-service science teachers in the literature (Bozdoğan, 2008; Çiçek & Saraç, 2017; Selanik-Ay & Erbasan, 2016). The result of this study is based on the science center observations and experiences of the pre-service elementary teachers. At this point, it is considered important that elementary teachers, who will also assume the role of science teaching, understand the importance of science centers in terms of supporting science teaching. Moreover, it can also be considered as an original result that pre-service teachers consider the science center to provide a vision of science teaching in teacher training. Another result obtained from

pre-service teachers' experiences is that the science center will support the learning of children and parents in terms of its contribution to science teaching. Öztürk and Laçin-Şimşek (2019) examined the behavior of families in the science center and determined that parents and children mostly preferred to perform the visit together. Compared with the results of this study, the contribution of the science center was determined by the pre-service teachers in terms of providing the child with the opportunity to learn science with their parents. It is anticipated that this outcome will guide prospective elementary teachers in terms of guiding the parents in their professional lives.

Another result that can be considered as part of the contribution dimension is how the pre-service teachers interpret the contribution of the science center to professional development. The pre-service teachers see science centers as an effective out-of-school learning environment for science teaching. Moreover, they see it as an opportunity, especially for schools that do not have laboratories or teaching materials. Another point that the pre-service teachers find important in terms of contribution to professional development is that the science center is an important component that supports the content knowledge. Various studies have also revealed that teachers should effectively guide their students and have sufficient content knowledge in science centers, which are an out-of-school learning environment (Dewitt & Hohenstein, 2010; Geveke et al., 2017; Krange et al., 2020; Luehmann & Markowitz, 2007; Tran, 2011; Turkmen, 2015). Thus, the present research has made elementary teachers aware that science centers are an opportunity for professional development.

Another result of the research is that the pre-service elementary teachers drew attention to the measures to be taken for the science center to provide more effective benefits and the improvements to be done within the scope of renovation works. Science center experiences of pre-service teachers indicate that science centers should be located closer to the city to increase the science literacy of society, reach more students, and be beneficial for all segments of society. In addition, suggestions were made that research centers or workshops should be established in different parts of the city and that the science center should carry out activities that provide access to society. Based on the experiences of the pre-service teachers in Konya Science Center, the exhibits that do not work in the science center should be repaired, and some closed galleries should be opened. Bozdoğan (2008), in their study at the Feza Gürsey Science Center, revealed that non-working exhibits constitute a problem faced by pre-service teachers. It can be suggested that the exhibits should be repaired, the closed galleries should be opened, and new galleries should be added in light of current scientific developments in order for the center to operate more effectively.

The results of this research, which is based on the experiences of pre-service elementary teachers visiting a science center, which is an informal learning environment, contain original findings regarding providing pre-service elementary teachers with a qualified science teaching vision and experience. Based on these findings, the effective use of science centers can be added to undergraduate programs as a separate applied course to attain well-equipped training for elementary teachers. However, considering the contribution of science centers to the city and region where they are located, it is necessary to take measures to ensure that these centers are utilized in the most effective way.

Acknowledgments

The study was not supported by any institution.

Statement of Responsibility

The authors contributed equally to the study.

Conflicts of Interest

The authors declare that there is no conflict of interest.

Author Bios:

Sema AYDIN CERAN works as an Assistant Professor Doctor at Selcuk University, Faculty of Education. She has a PhD degree in science education at Gazi University. She has carried out nationally supported projects such as parent trainings, improving pre-service teachers' science lesson planning skills and organizing a science fair. Her research interests are teacher education, real-life context based learning approach, scientific process skills, conceptual understanding, different cognitive styles and learning, science education for primary school students and pre-service elementary teachers, scientific literacy and scientific creativity.

Seher ESEN works as a research assistant at Selcuk University, Faculty of Education. She continues her doctoral studies in basic education at Necmettin Erbakan University. Her research interests are teacher education, village institutes, science education for primary school, scientific literacy, epistemological beliefs, nature of science and scientific process skills.

References

Agar, M. H., Glaser, B. G., Strauss, A. L., Hammersley, M., Hammersley, M., Kirk, M., & Silverman, D. (2004). Quality and credibility. In Seale, C., Gobo, G., Gubrium, JF, & Silverman, D. (Eds), *Qualitative research practice* (pp. 378-378). Sage.

Akar, H. (2016). Durum Çalışması. In A. Saban & A. Ersoy (Eds.), *Eğitimde nitel araştırma desenleri* (pp. 111-150). Anı Yayıncılık.

Yeltekin Atar, B. Ş., Aykutlu, I., & Bayrak, C. (2021). Türkiye'de son 10 yılda fizik eğitiminde kavram yanılgılarıyla ilgili yapılan çalışmaların değerlendirilmesi. *Atatürk Üniversitesi Kazım Karabekir Eğitim Fakültesi Dergisi*, (42),304-323. https://doi.org/10.33418/ataunikkefd.831817

Aksoğan, M., & Bulut Özek, M. (2020). Öğretmen adaylarının teknoloji yeterlilikleri ile teknolojiye bakış açısı arasındaki ilişki. *Gümüşhane Üniversitesi Sosyal Bilimler Dergisi, 11*(2), 301-311. https://dergipark.org.tr/en/pub/gumus/issue/55299/661961

Arastaman, G., Öztürk Fidan, İ., & Fidan, T. (2018). Nitel araştırmada geçerlik ve güvenirlik: Kuramsal bir inceleme. *Van Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi, 15*(1), 37-75. http://dx.doi.org/10.23891/efdyyu.2018.61

Arslan, S., Kutluca, T., & Özpinar, I. (2011). Investigating mathematics teacher candidates' opinions about using ınformation & communication technologies. *Cypriot Journal of Educational Sciences*, *2*, 75-82.

Bell, P., Lewenstein, B., Shouse, A. W., & Feder, M. A. (Eds.). (2009). *Learning science in ınformal environments: people, places, and pursuits.* National Academies Press.

Bleicher, R. E. (2007). Nurturing confidence in preservice elementary science teachers. *Journal of Science Teacher Education, 18*(6), 841-860. https://doi.org/10.1007/s10972-007-9067-2

Bozdoğan, A. E. (2008). Fen bilgisi öğretmen adaylarının bilim merkezlerini fen öğretimi açısından değerlendirmesi: Feza Gürsey Bilim Merkezi örneği. *Uludağ Üniversitesi Eğitim Fakültesi Dergisi, 21*(1), 19-41. https://dergipark.org.tr/en/pub/uefad/issue/16687/173403

Burkut, E. B. (2018, May). Bilim merkezlerinin mekansal tasarım-kullanım bağlamında incelenmesi: Konya Bilim Merkezi örneği. *Uluslararası Yeşil Başkentler Kongresi*, Konya (8-11 Mayıs 2018).

Carrier, S. J. (2009). The effects of outdoor science lessons with elementary school students on preservice teachers' self-efficacy. *Journal of Elementary Science Education, 21*(2), 35-48. https://doi.org/10.1007/bf03173683

Carrier, S. J., Whitehead, A. N., Walkowiak, T. A., Luginbuhl, S. C., & Thomson, M. M. (2017). The development of elementary teacher identities as teachers of science. *International Journal of Science Education, 39*(13), 1733-1754. https://doi.org/10.1080/09500693.2017.1351648

Creswell, J. W. (2019). *Nitel araştırmacılar için 30 temel beceri* (H. Özcan, Trans. Ed.; 2 ed.). Anı Yayıncılık.

Creswell, J. W. (2020). *Eğitim araştırmaları: nicel ve nitel araştırmanın planlanması, yürütülmesi ve değerlendirilmesi* (H. Ekşi, Trans. Ed.; 3. ed.). EDAM Yayınları. (2012, 4. baskı)

Çavuş-Güngören, S., & Hamzaoğlu, E. (2020). Fen bilgisi öğretmen adaylarının ortak bilgi yapılandırma modeli hakkındaki görüşleri. *Kastamonu Eğitim Dergisi, 28*(1), 107-124. https://doi.org/10.24106/kefdergi.3465

Çermik, H. (2013). Öğretmen adaylarının zihinlerinde canlanan resimdeki bilim insanı. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi, 33*(33), 139-153. https://doi.org/10.9779/PUJE612

Çetin, O., Çalışkan, E., & Menzi, N. (2012). Öğretmen adaylarının teknoloji yeterlilikleri ile teknolojiye yönelik tutumları arasındaki ilişki. *İlköğretim Online, 11*(2), 273-291.

Çiçek, Ö., & Saraç, E. (2017). Fen bilimleri öğretmenlerinin okul dışı öğrenme ortamlarındaki yaşantıları ile ilgili görüşleri. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi, 18*(3), 504-522.

Denzin, N. K., & Lincoln, Y. S. (Eds.). (2011). *The Sage handbook of qualitative research*. Sage.

Dewitt, J., & Hohenstein, J. (2010). School trips and classroom lessons: An investigation into teacher-student talk in two settings. *Journal of Research in Science Teaching, 47*(4), 454-473. https://doi.org/10.1002/tea.20346

Dohn, N. B. (2013). Upper secondary students' situational interest: a case study of the role of a zoo visit in a biology class. *International Journal of Science Education, 35*(16), 2732-2751. https://doi.org/10.1080/09500693.2011.628712.

Erçetin, Ş. Ş., & Görgülü, D. (2018). Bilim merkezlerini ziyaret eden 6. sınıf öğrencilerinin fen bilimleri dersine ilişkin görüşlerinin incelenmesi: Konya bilim merkezi örneği. *Journal of Turkish Educational Sciences, 16*(2), 122-138.

Eren-Sisman, E. N., Cigdemoglu, C., Kanli, U., & Koseoglu, F. (2020). Science teachers' professional development about science centers enhancing science teachers' views concerning nature of science. *Science & Education, 29*(5), 1255-1290. https://doi.org/10.1007/s11191-020-00136-4

Eryılmaz, A., & Tatlı, A. (2000). ODTÜ öğrencilerinin mekanik konusundaki kavram yanılgıları. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 18*(18). https://open.metu.edu.tr/handle/11511/75415

Geveke, C. H., Steenbeek, H. W., Doornenbal, J. M., & Van Geert, P. L. C. (2017). Attractor states in teaching and learning processes: a study of out-of-school science education. *Frontiers in Psychology, 8*, Article 299.

Glesne, C. (2020). *Nitel Araştırmaya Giriş* (Ali Ersoy & P. Yalçınoğlu, Trans. Eds.; 6 ed.). Anı Yayıncılık. (2011, 4. edition)

Görkemli, H. N., & Solmaz, B. (2012). Bilim merkezlerinin kent markalaşmasındaki rolü ve konya örneği. *İletişim Kuram ve Araştırma Dergisi*, (34), 98-109.

Gülçiçek, Ç., & Yağbasan, R. (2004). Basit sarkaç sisteminde mekanik enerjinin korunumu konusunda öğrencilerin kavram yanilgilari. *Gazi Eğitim Fakültesi Dergisi, 24*(3).

Guisasola, J., Morentin, M., & Zuza, K. (2005). School visits to science museums and learning sciences: A complex relationship. *Physics Education, 40*(6), 544. https://doi.org/10.1088/0031-9120/40/6/006

Kazempour, M., & Sadler, T. D. (2015). Pre-service teachers' science beliefs, attitudes, and self-efficacy: a multi-case study. *Teaching Education, 26*(3), 247-271. https://doi.org/10.1080/10476210.2014.996743

Kisiel, J. (2006). An examination of fieldtrip strategies and their implementation within a natural history museum. *Science Education, 90*(3), 434-452. https://doi.org/10.1002/sce.20117

Köseoğlu, F., Tahancalıo, S., Kanlı, U., & Özdem Yılmaz, Y. (2020). Investigation of science teachers' professional development needs for learning in science centers. *TED Eğitim ve Bilim, 45*(203), 191-213. https://doi.org/10.15390/eb.2020.8725

Krange, I., Silseth, K., & Pierroux, P. (2020). Peers, teachers and guides: a study of three conditions for scaffolding conceptual learning in science centers. *Cultural Studies of Science Education, 15*(1), 241-263. https://doi.org/10.1007/s11422-018-9905-x

Kubiatko, M., Usak, M., Yilmaz, K., & Tasar, M. F. (2010). A cross-national study on Czech and Turkish university students' attitudes towards ICT used in science subjects. *Journal of Baltic Science Education, 9*(2), 119-134.

Laçin-Şimşek, C., & Öztürk, M. (2021). An examination of science center visitors' interactions with exhibits. *Museum Management and Curatorship*, 1-21. https://doi.org/10.1080/09647775.2021.1891560

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage Publications.

Luehmann, A. L., & Markowitz, D. (2007). Science teachers' perceived benefits of an out-of-school enrichment programme: identity needs and university affordances. *International Journal of Science Education, 29*(9), 1133-1161. https://doi.org/10.1080/09500690600944429

Lye, H., Fry, M., & Hart, C. (2002). What does it mean to teach physics 'in context'? A first case study. *Australian Science Teachers Journal, 48*(1), 16-22.

Medved, M. I., & Oatley, K. (2000). Memories and scientific literacy: remembering exhibits from a science centre. *International Journal of Science Education, 22*(10), 1117-1132. https://doi.org/10.1080/095006900429475

Miles, M. B., & Huberman, A. M. (2019). *Genişletilmiş bir kaynak kitap: Nitel veri analizi* (S. A. Altun & A. Ersoy, Trans. Eds.; 3. ed.). Pegem Akademi. (2. Edition, Sage Publications).

Millî Eğitim Bakanlığı. (2018). *Fen bilimleri dersi öğretim programı (3, 4, 5, 6, 7 ve 8. Sınıflar)*.

Mintzes, J. J., Marcum, B., Messerschmidt-Yates, C., & Mark, A. (2013). Enhancing self-efficacy in elementary science teaching with professional learning communities. *Journal of Science Teacher Education, 24*(7), 1201-1218. https://doi.org/10.1007/s10972-012-9320-1

Morentin, M., & Guisasola, J. (2015). Primary and secondary teachers' ideas on school visits to science centres in the Basque Country. *International Journal of Science and Mathematics Education, 13*(1), S191-S214. https://doi.org/10.1007/s10763-013-9481-1.

NRC. (2009). *Learning Science in Informal Environments: People, Places, and Pursuits*. The National Academies Press.

Oğuz Ünver, A. (2010). Bilim insanlarını algılama: ilköğretim 5. sınıf öğrencileri ile son sınıf öğretmen adaylarının karşılaştırılması. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi, 4* (1), 11-28. https://dergipark.org.tr/en/pub/balikesirnef/issue/3370/46516

Ok, Z., & Aslan, O. (2020). Konya Bilim Merkezi'nde gerçekleştirilen atölye çalışmalarının ilkokul ve ortaokul öğrencileri tarafından değerlendirilmesi. Cumhuriyet *International Journal of Education, 9*(1), 28-45. http://dx.doi.org/10.30703/cije.522419

Organization for Economic Co-operation and Development. (2019). PISA 2018 results (Volume I): What students know and can do. OECD Publishing. https://doi.org/10.1787/5f07c754-en

Özdemir, U., & Taç, İ. (2017). Sınıf öğretmeni adaylarının teknolojiye yönelik tutumlarının belirlenmesi. *International Primary Education Research Journal, 1*(1), 1-7.

Öztürk, M., & Şimşek, C. L. (2019). Bilim merkezinde ailelerin davranışlarının ve düzeneklere yönelik ilgilerinin incelenmesi: Bilim Üsküdar örneği. *İnformal Ortamlarda Araştırmalar Dergisi, 4*(1), 1-21.

Palmer, D. H. (2006). Sources of self-efficacy in a science methods course for primary teacher education students. *Research in Science Education, 36*(4), 337-353. https://doi.org/10.1007/s11165-005-9007-0

Patton, M. Q. (2018). *Nitel araştırma ve değerlendirme yöntemleri* (Mesut Bütün & S. B. Demir, Trans. Eds.; 2. ed.). Pegem Akademi. (3rd edition).

Phillips, M., Finkelstein, D., & Wever-Frerichs, S. (2007). School site to museum floor: how informal science institutions work with schools. *International Journal of Science Education, 29*(12), 1489-1507. https://doi.org/10.1080/09500690701494084

Rodéhn, C. (2019). Science centres, gender and learning. *Cultural Studies of Science Education, 14*(1), 157-167. https://doi.org/10.1007/s11422-018-9880-2

Ross, K., Lakin, L., McKechnie, J., & Baker, J. (2010). *Teaching secondary science: Constructing meaning and developing understanding*. Routledge.

Sáinz, M., & López-Sáez, M. (2010). Gender differences in computer attitudes and the choice of technology-related occupations in a sample of secondary students in Spain. *Computers & Education, 54*(2), 578-587. https://doi.org/10.1016/j.compedu.2009.09.007.

Saldana, J. (2019). *Nitel araştırmacılar için kodlama el kitabı*. (A., Tüfekçi Akcan & S. N., Şad, Trans.). Pegem Akademi. (Orijinal eserin yayın tarihi 2009)

Salmi, H. S. (1993). *Science centre education: Motivation and learning in informal education* [Unpublished Doctoral Dissertation], Helsingin Yliopisto.

Sayar, G., & Arat, Y. (2017). İmaj yapı tasarımında evrensel tasarım ilkelerinin rolü; Konya bilim merkezi örneği. *Mühendislik Bilimleri ve Tasarım Dergisi, 5*(Special Issue), 145-155. https://doi.org/10.21923/jesd.20284

Selanik-Ay, T., & Erbasan, O. (2016). Views of classroom teachers about the use of out of school learning environments. *Journal of Education and Future-Egitim ve Gelecek Dergisi,* (10), 35-50.

Shein, P. P., Falk, J. H., & Li, Y. Y. (2019). The role of science identity in science center visits and effects. *Science Education, 103*(6), 1478-1492. https://doi.org/10.1002/sce.21535

Steele, A., Brew, C., Rees, C., & Ibrahim-Khan, S. (2013). Our practice, their readiness: teacher educators collaborate to explore and improve preservice teacher readiness for science and math instruction. *Journal of Science Teacher Education, 24*(1), 111-131. https://doi.org/10.1007/s10972-012-9311-2

Şentürk, E. (2015). *Field trips to science centers: Teachers' perspectives, roles and reflections* [Unpublished doctoral dissertation]. Middle East Technical University.

Şentürk, E., & Özdemir, Ö. F. (2014). The effect of science centres on students' attitudes towards science. International. *Journal of Science Education, Part B, 4*(1), 1-24. https://doi.org/10.1080/21548455.2012.726754

Tasdemir, A., Kartal, T., & Ozdemir, A. M. (2014). Using science centers and museums for teacher training in Turkey. *The Asia-Pacific Education Researcher, 23*(1), 61-72. https://doi.org/10.1007/s40299-013-0085-x

Tlili, A., Cribb, A., & Gewirtz, S. (2006). What becomes of science in a science centre? Reconfiguring science for public consumption. *The Review of Education, Pedagogy, and Cultural Studies, 28*(2), 203-228. https://doi.org/10.1080/10714410600739921

Tran, N. A. (2011). The relationship between students' connections to out-of-school experiences and factors associated with science learning. *International Journal of Science Education, 33*(12), 1625-1651. https://doi.org/10.1080/09500693.2010.516030

Türkmen, H. (2015). İlkokul öğretmenlerin sınıf dışı ortamlardaki fen öğretimine bakış açıları. *Journal of European Education, 5*(2), 47-55.

Weitze, M.-D. (2003, June 1-6). Science centers: Examples from the US and from Germany [Conference session]. *From the itinerant lecturers of the 18th century to popularizing physics in the 21st century–exploring the relationship between learning and entertainment*, Pognana sul Lario, Italy.

World Economic Forum. (2020). *Schools of the future [REF 09012020*]. World Economic Forum.

Yıldırım, A., & Şimşek, H. (2021). *Sosyal bilimlerde nitel araştırma yöntemleri*. Seçkin Yayıncılık.

Yıldız Kuyrukçu, E. (2018). The importance of iconic buildings for city image: Konya Science Center example. *Iconarp International J. of Architecture and Planning, 6*(2), 461-481. https://doi.org/10.15320/iconarp.2018.63

Yolcu, H., & Karamustafaoğlu, O. (2021). Konya Bilim Merkezine yapılan bir sanal gezintinin bilimsel etkisi hakkında öğretmen görüşleri. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi, 22* (3), 1925-1983. https://doi.org/10.29299/kefad.936252