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Research Article

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The Impact of Using Dynamic Mathematics Learning Objects on Pre-Service Mathematics Teachers' Motivation and Cognitive Load Levels

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Abstract

Computer-assisted mathematics education (CAME) continues to be the focus of interest for today's educators. This study aimed to investigate the impact of teaching with dynamic mathematics learning objects (DMLO) in CAME on pre-service mathematics teachers' motivation and cognitive load. The sample of the study, which used an explanatory design, one of the mixed research methods, consisted of 24 pre-service mathematics teachers. The experimental group participated in learning activities with DMLO prepared as part of CAME. The results of the study showed that CAME using DMLO significantly impacted the motivation and cognitive load of pre-service teachers. The visuals and graphics used were evaluated as interesting, fun and engaging by the pre-service teachers. The results were analyzed along with the qualitative data obtained in accordance with the pre-service mathematics teachers' opinions and experiences, and the reasons for the quantitative results were explained. DMLOs can be offered to higher education students taking mathematics courses in different departments of universities. In addition to regular teaching, it may be useful to ensure the use of DMLOs as extracurricular materials through mobile devices.

Keywords: Computer-assisted Mathematics Education, Dynamic Mathematics Learning Objects, Motivation, Cognitive Load

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Dinamik Matematik Öğrenme Nesnelerin Kullanımının Matematik Öğretmen Adaylarının Motivasyon ve Bilişsel Yük Düzeylerine Etkisi

Özet

Bilgisayar destekli matematik eğitimi (BDME) günümüz eğitimcilerinin ilgi odağı olmaya devam etmektedir. Bu çalışmanın amacı BDME'de dinamik matematik öğrenme nesneleri (DMÖN) ile öğretimin matematik öğretmen adaylarının motivasyonu ve bilişsel yükü üzerindeki etkisini araştırmaktır. Karma araştırma yöntemlerinden biri olan açıklayıcı desenin kullanıldığı çalışmanın örneklemini 24 matematik öğretmeni adayı oluşturmaktadır. Deney grubu, BDME kapsamında hazırlanan DMÖN ile öğrenme etkinliklerine katılmıştır. Çalışmanın sonuçları, DMÖN kullanılan BDME'nin öğretmen adaylarının motivasyonunu ve bilişsel yükünü önemli ölçüde etkilediğini göstermiştir. Kullanılan görseller ve grafikler öğretmen adayları tarafından ilginç, eğlenceli ve ilgi çekici olarak değerlendirilmiştir. Sonuçlar, matematik öğretmen adaylarının görüşleri ve deneyimleri doğrultusunda elde edilen nitel verilerle birlikte analiz edilmiş ve nicel sonuçların nedenleri açıklanmıştır. DMÖN'leri üniversitelerin farklı bölümlerinde matematik dersi alan yükseköğretim öğrencilerine sunulabilir. Yüzyüze öğretimin yanı sıra mobil cihazlar aracılığıyla DMÖN''leri ders dışı materyal olarak kullanımının sağlanması faydalı olabilir.

Anahtar Kelimeler: Bilgisayar Destekli Matematik Eğitimi, Dinamik Öğrenme Nesneleri, Motivasyon, Bilişsel Yük

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1. Introduction

The innovations in the field of instructional technologies and the increasing flood of information have made it necessary to use computers as a dominant tool in the learning process where people need and receive more information. Nowadays, computers continue to be used extensively to ensure active participation in learning and teaching processes in educational areas associated with information technologies (IT). Depending on the innovations in information technology, we also witness essential changes and developments in the design of teaching materials. These developments mean that the integration of education and technology is inevitable and requires teachers to adapt more to technology (Özerbaş & Yalçınkaya, 2018).

The necessity of using computers and computer-based technological tools in the educational environment is increasing day by day to make education more efficient, to deal with the increasing complexity of content taught due to the increasing amount of information, to take into account individual needs and new approaches to learning (Gülcü & Alan, 2003; Şataf, 2009; Çelik et al., 2015). IT is considered an effective tool to promote teachers' competence and students' achievement in all educational programs. Based on this, computer-assisted instruction is on the rise, continuing to evolve with each passing day and changing perceptions. (Demirci, 2008; Gülcü et al., 2013). Computers are an essential pedagogical tool for creating an individual learning environment and making knowledge permanent (Kesicioğlu, 2011). With the widespread use of computer technologies in education, multimedia teaching is also widely used (Zhang et al., 2022). Multimedia teaching is considered necessary to motivate students, support lifelong learning, and make the curriculum flexible (Uşun, 2004).

In the literature, multimedia is referred to as educational tools that motivate learners by combining textual elements with images, diagrams, shapes, videos, animations, and sound in learning-teaching activities via IT (Özerbaş & Yalçınkaya, 2018). On this basis, multimedia is believed to increase students' interest and motivation and help develop a positive attitude toward learning by appealing to more than one sensory organ and one type of intelligence (Arslan & Bilgin, 2020). The use of multimedia in the educational environment can arouse students' attention and increase their motivation (Erce, 2021). As the use of multimedia in the learning process simplifies learning, the information becomes more understandable. Multimedia helps to concretize abstract expressions and enables meaningful learning

(Efendioğlu, 2015). Computer-assisted instruction (CAI) applications are also popular because the need for information increases with the introduction of computers into learning environments that usually incorporate multiple media tools. With CAI, students can identify and address their shortcomings on a subject matter by interacting with the computer during the lesson, work in their own time and way by identifying their own learning speed, receive feedback, and see what they have done right or wrong, increase their interest in the lesson thanks to animations, images, sounds, and shapes (Cingi, 2013).

If we consider where CAI is used, computers, considered a tool in education, are used in almost all areas. The use of animations in a spectrum ranging from entertainment to education, from commercials to visual effects is increasing through the proliferation of computer-based instruction (Bağcı & Başaran, 2019; Topçu et al., 2014). The use of web-based games and gamification animations in computer-based education environments is widespread (Solmaz et al., 2018), CAI supports lifelong learning (Sarıtepeci & Orak, 2019), and enables the use of the formal education curriculum outside school boundaries so that individuals can continue their education according to their own pace and interests (Kaleli-Yılmaz & Zengin, 2019).

Studies on computer-based mathematics teaching have gained momentum to provide qualified teaching in mathematics courses where abstract concepts are predominant, based on CAI combining education and technology on a strong foundation (Erce, 2021). Studies report that in mathematics classes, CAME (Computer Assisted Mathematics Education) makes difficult-to-understand and abstract topics more comprehensible, leading to more permanent learning (Gülcü et al., 2013). CAME plays an important role in introducing innovative approaches in mathematics education. For students to easily understand concepts, relationships, algebraic and geometric structures, and algorithms in mathematics, teachers and students often resort to CAME (Herawaty et al., 2019). In mathematics teaching, computer-based materials are used as part of planned instructional activities at appropriate times (Kağızmanlı & Tatar, 2013). In the creation of instructional content, software, i.e., computer-based instructional materials, are used. Software that enables the teaching and learning of mathematics includes computer algebra systems based on processing symbolic expressions (Hohenwarter & Jones, 2007). These systems are designed to make abstract mathematical objects concrete, allowing students to use a variety of senses as they are visual and dynamic (Santi, 2011). Dynamic mathematics learning objects (DMLOs) created using mathematics software can easily convey abstract mathematical

concepts, the relationships between them, and the existence of equality. With the introduction of brand-new pedagogical approaches, these tools are now widely used at all levels of education. It is now possible to develop and design DMLOs using Mathematica (Gülcü, 2004), a symbolic mathematics software produced by Wolfram Research. The Mathematica programming language is an object-oriented software with a graphical interface. Dynamic materials created with this software have a positive impact on learning. The use of DMLO's in university mathematics education, where abstract concepts are predominant, aims to provide students with an enjoyable learning process and ensure complete learning by equipping them with permanent and high-level learning skills (Yağcı, 2017).

In higher education, many students encounter problems in mathematical subjects, mostly related to skills requiring abstract thinking (Paridjo & Waluya, 2017). According to Jackson (2008), negative perceptions of learning difficulties in mathematics have an impact on student learning. Attitudes toward mathematics and cognitive abilities impact students' learning of mathematics. Therefore, in addition to arousing positive beliefs and feelings about mathematics competence in students, it can contribute to the understanding of the content by increasing students' interest in the lesson and saving them from having to deal with piles of information (Yağcı, 2017). In this respect, it is possible to enable students to learn mathematics better by increasing their motivation and reducing their cognitive load (Timmerman et al., 2017).

1.1. Theoretical Framework

1.1.1. Learning Motivation and Cognitive Load

One of the important factors affecting the learning process is learning motivation. Studies on motivation define motivation in different ways. According to Emda (2018), motivation is the internal power to continue individual activities. Lin et al. (2018) defined motivation as the effort that sets the direction and magnitude of behavior. Motivation, necessary for behavioral change, is also necessary for learning (Sevinç et al., 2011). Researchers have revealed that highly motivated students are more curious, persistent, determined, excited, diligent, and interested in the learning process compared to low-motivated students (Jong et al., 2017; Süren, 2019). In fact, studies have reported that highly motivated students learn more, want to continue their education and feel better in proportion to their learner traits (Smith et al., 2014). In respect of ensuring students' motivation in the teaching process, plans should be made to increase student

motivation while designing the teaching process. Studies emphasize that it is important for students to have high levels of motivation in order to participate effectively in the learning process (Saggaf et al., 2018). The current study analyzed the impact of using DMLOs, based on the CAME method, on students' motivation in mathematics learning.

In addition to its affective effects in the learning process, the CAME method also has an impact on cognitive processes. Cognitive load can be defined as the information density in a student's cognitive systems at any given time (Sweller et al., 2019; Witte et al., 2015; Liao & Lin, 2016). Cognitive load addresses the instructional implications of the limited capacity of human memory and the development of instructional methods that enable students to effectively use their limited information processing capacity (Paas, Renkl & Sweller, 2003). The capacity of working memory is thought to be limited in terms of the amount of information that can be processed and the time in which that information can be stored. When these limits are exceeded, cognitive overload situations occur. The amount of mental resources required for learning can be defined as three basic constructs of cognitive load. These are intrinsic, extraneous, and germane cognitive loads (Leppink & Van der Heuvel, 2015; Liao & Lin, 2016). (1) Intrinsic cognitive load is the mental effort that the task to be performed in a learning environment causes in students' cognitive structures. It depends on the internal structure of the learning task and the learners' prior knowledge about the task. It refers to the amount of information in working memory during the learning process (Vogel-Walcutt et al., 2011; Van Merrienboer & Ayres, 2005). (2) Extraneous cognitive load, occurs, in contrast to internal cognitive load, as a result of unnecessary cognitive activities that are irrelevant to the learning goals, and unnecessary memory effort. External cognitive load is usually caused by poorly planned instructional design (Vogel-Walcutt et al., 2011). (3) Germane cognitive load refers to the basic processing of knowledge to create new knowledge structures (Sweller et al., 2019; Liao & Lin, 2016). It occurs in the process of creating schemas that play an important role in the learning process. In designing the learning process and learning materials, it is important to create a balance these three types of cognitive loads by reducing the roles of the intrinsic and extraneous loads and increasing that of the germane cognitive load. DMLOs have significant potential in terms of reducing students' cognitive load and facilitating an effective learning process by providing students with a multimedia learning environment. On that basis, the current study examined the impact of DMLOs on the cognitive loads of students.

1.2. Related Studies

Along with the developments in computer technologies, there is a burgeoning interest in CAME. Studies argue that the use of dynamic geometry software in the teaching of math subjects positively affects students' learning of geometry (Güven, 2002); that the use of CAME materials has a positive impact on students' attitudes towards mathematics (Baki et al., 2007) besides increasing students' mathematical problem solving skills and improving their approaches to solving mathematical problems (Lazakidou & Retalis, 2010). Studies also show that students exposed to dynamic visual materials exhibit high levels of mathematical self-efficacy, improve their problem-solving skills, and develop a better understanding of concepts and mathematical processes (Kohen et al., 2022). Doğanay and Dinçer (2017) also showed that students who can personalize educational software and use software with learning interfaces are more likely to embrace CAME. Kağızmanlı and Tatar (2012) found in their study on pre-service teachers that CAI with dynamic mathematics software concretizes and visualizes the subject matter and enables students to draw conclusions. Zengin et al. (2013) concluded that pre-service teachers were not only able to learn at their own pace thanks to dynamic math teaching objects such as visualization, facilitation, and concretization, but also that learners found it easier to remember the subject matters while enjoying higher levels of interest in math. Takaci et al. (2015) found in their study that students who used GeoGebra had better learning success in examining functions and drawing charts than students who did not. İliç and Akbulut (2019), in their study examining the effects of different fluency manipulations on learning outcomes, metacognitive assessment, and cognitive load, concluded that fluency manipulations in learning materials lead to better learning success by interfering with fluency, while the use of visual materials increased cognitive load. On the other hand, Lehmann et al. (2016) concluded that visuals with fluency potential used in the learning process facilitated the acquisition of new information by reducing the cognitive load of individuals.

1.3. Rationale and Importance of the Study

Today, it can be argued that approaches to teaching mathematics have changed significantly due to the rapid advances in technology. There is now more focus on the use of cognitive tools that facilitate the learning of math and support the teacher in the teaching process. Instead of taxing the mind, memorizing a lot of abstract information, and subjecting students to tedious procedures, there is emphasis on alternative methods such as CEMA to help students develop

mathematical thinking and problem-solving skills. Integrating education and technology, mathematics education strives to grow individuals who can continuously learn, think critically, ask questions, and keep up with innovations and new developments.

Many materials, both print and digital, are used to facilitate learning. The development of computer-based technologies has led to the frequent use of digital learning materials in the classroom. One of the most important digital learning materials is CAI, which involves multiple learning. In this regard, there is a need for DMLO materials in mathematics education where abstract concepts are prevalent (Golezani & Gülcü, 2021). The use of DMLOs in learning environments provides richer learning opportunities by putting the student at the center; it allows students to do and love mathematics, making teaching of mathematics fun, and providing an environment where mathematics can be written and discussed. It is predicted that the use of DMLOs in teaching mathematics on the basis of the method of CAME has multiple effects such as providing an effective learning environment for individuals, achieving an ideal level of learning and motivation to learn, and reducing cognitive load. There is a need for extensive and more studies on this subject at different educational levels. There are studies that examine various variables related to the use of DMLOs in learning at the college level. However, there are a limited number of studies on pre-service mathematics teachers' motivation and cognitive load. In addition, utilization of DMLOs in studies conducted with pre-service teachers, the teachers of the future, may ensure the widespread use of DMLOs at different levels of education.

The objective of this research is to demonstrate the impacts of using DMLOs in math education on pre-service mathematics teachers' motivation and cognitive load. The general objective of this research provides for the investigation of the following sub-objectives:

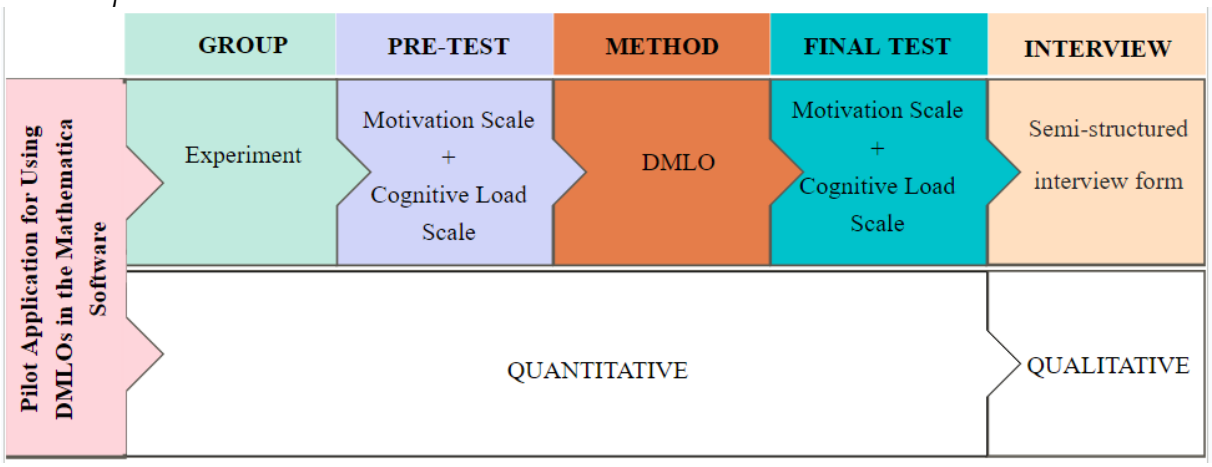
1. Does the use of DMLOs have a significant impact on the motivation of pre-service mathematics teachers?
2. What is the level of cognitive load of pre-service mathematics teachers who used DMLOs?
3. What are the opinions and experiences of pre-service mathematics teachers toward using DMLOs in learning process?

2. Method

For purposes of this study, we employed explanatory design, which is one of the mixed research methods. According to Creswell (2017), mixed methods research is a research approach that involves the use of qualitative and quantitative research methods or paradigms together. With explanatory design, quantitative data are collected firstly, followed by qualitative to explain the quantitative data. Data collected by quantitative and qualitative methods support each other. One of the reasons for choosing the mixed research method is complementation and diversification. Thanks to diversification, a situation examined using the quantitative method can also be examined using the qualitative method and the results are confirmed. In this study, instead of conducting a one-way analysis, we used different methods to obtain more comprehensive results (Yıldırım & Şimşek, 2011).

We determined participants' cognitive load and motivation levels using quantitative methods. Then, we used qualitative methods to analyze and interpret the quantitative variables in detail. For the quantitative aspect of the study, we used a one-group pretest-posttest pre-experimental design. The experimental group had various measurements made before and after the application. The independent variable of the study was DMLO while the dependent variables were pre-service mathematics teachers' motivation and cognitive load level. For the qualitative aspect of the study, we used the case study method to determine the their views on DMLOs. The research model conducted in accordance with the research method was summarized in Figure 1.

Figure 1.
Research process



2.1. Study Group

The study group of this research consisted of twenty-four (thirteen female, eleven male) first-year students enrolled in the Department of Elementary Mathematics Teaching at the Faculty of Education of Siirt University in the 2021-2022 academic year.

We determined the study group by utilizing the purposeful sampling method. All of the pre-service mathematics teachers in the experimental group stated that they were volunteers. Ethics committee permission was also obtained for the study. We informed the pre-service teachers in the experimental group about the process to be carried out within the scope of the course specified in the work schedule in Table 1 and explained the procedures in detail.

Table 1.
Experimental Group's Course Process

	1st Week	2nd Week	3rd Week	4th Week
EXPERİMENTAL GROUP	Training on Mathematica software and information about how to use it Realization of the pilot application Pre-test	Implementation of pre-tests Definite / indefinite integrals with DMLOs, integrals separable into variables Implementation of Cognitive Load Scale at the end of the course.	Remainder calculation, Riemann sum and integrable continuous functions with DMLO Implementation of the Cognitive Load Scale at the end of the course	Integration of rational functions, visual calculation of an integral with DMLO Post-test Conducting interviews for situation assessment

2.2. Research Process

2.2.1. Prior to the Experimental Study

Before starting the application, we made a preparation for the DMLOs to be employed in the process. Expert opinions were sought for the creation of the objects and we decided to use the Wolfram Mathematica 11.0 software package, the license of which belongs to Atatürk University. We opted for materials created using the Mathematica software because they create an interactive environment for students and provide an active learning environment. DMLOs, designed by incorporating expert opinions during the object development phase, needed to be fun, easy to use, user-friendly, include feedback, and be suitable for different learning levels, among other requirements. At the same time, we designed the DMLOs in terms of visuals and content while creating codes in the Wolfram programming language. We designed DMLOs was designed in such a way as to be used flexibly and modified in different ways depending on the student's position in relation to the screen. Designing the visuals in accordance with the level of understanding and comprehension of the concepts facilitated the use of the objects. We designed the DMLOs according to the principles of the theory of cognitive load in multimedia learning. We converted the objects as a ".cdf" extension, to be in the form of an interactive Mathematica file. To use the objects on computers, we used the CDF player, which is offered free of charge by Wolfram. Thanks to this software, the objects can be used on Mac, Windows, and Linux operating systems, regardless of the Mathematica platform. At the same time, installing the CDF file player on the student computers instead of the Mathematica software reduced the workload and made working with the objects more efficient. Another important aspect of the Wolfram technology, namely its taking up as little memory as possible, proved to be an advantage in the experimental environment. In this way, the size of the prepared objects on the diskette was at the KB (kilobyte) level, which eliminated the problems of usage and transportation. We designed the learning objects in such a way that pre-service teachers could eventually use them and transferred them to computers using portable floppy disks. The necessary permissions were obtained for the use of the computer laboratory of the Faculty of Education of the University of Siirt, where the application was to be carried out, and the objects were made available on the computers.

2.2.2. Experimental Study Process

As part of the four-week study, a pilot application was conducted during the first week, and pre-service teachers were informed about the process. Following the pilot training on the use of Mathematica software, pre-service mathematics teachers learned the basic usage functions of Mathematica, how to use integral charts, and how to utilize the dynamic object interface by directly working on objects. In the first week after the training week, the pre-service teachers learnt about definite and indefinite integrals and integrals separable into variables using DMLOs. The theoretical information on the subject was provided by the instructor, and they were introduced to charts/visuals practically by solving practice questions using DMLOs. In the second week, they learned about the development of the theoretical structure of integral calculus via remainder calculation, Riemann sum, and integrability of continuous functions with instructors explaining the subject matter with the help of dynamic charts. During this week, they solved many questions and made comments on various outputs of objects. In the third week, they learned about the integration of rational functions and visual calculation of an integral using dynamic objects and acquired the ability to interpret the integrals using visuals.

We designed the DMLOs in accordance with the subject matter of "Integral" contained in the course Analysis II, taught in the fall semester of the first year at the Faculty of Education, Department of Elementary School Math Teaching. We collected technical and cognitive information, such as the necessary information about the topic and the limitations of the material to be prepared based on the respective course instructor and the standard curriculum set by the Council of Higher Education, and the coding phase was started using Mathematica 11 software. We addressed any shortcomings with the help of expert opinions, and the prepared material was brought to a level that could be used by the pre-service teachers. The pre-service teachers used the mathematics learning objects in the computer laboratory environment on the day specified in the program during the course hours for four weeks. The images related to the use and application of DMLOs in the teaching process during the experiment process are presented in Figure 2 and Figure 3.

Figure 2.
Visuals related to DMOL for Visual Calculation of Area, Riemann Sum and Integral

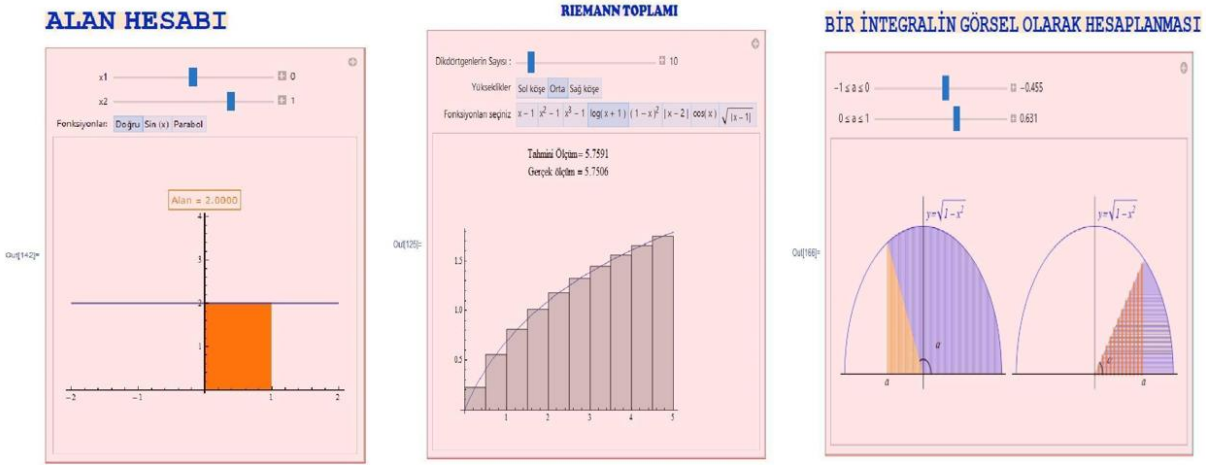


Figure 3.
Images from the experiment process

2.3. Data Collection Tools

2.3.1. Instructional Materials Motivation Scale

We used the "Instructional Materials Motivation" scale developed by Keller (1983) and adapted into Turkish by Kutu and Sözbilir (2011) to determine pre-service mathematics teachers' learning motivation levels towards Mathematics. The 5-point Likert scale consisted of two sub-dimensions, "Attention-Relevance" and "Confidence-Satisfaction", and twenty-four items. In the Attention-Relevance dimension of the scale, there were items related to arousing the student's curiosity and interest in the lesson and maintaining this interest until the lesson's end and the subject's suitability to the student's personal needs and goals. In the Confidence-Satisfaction dimension of the scale, there were items related to students realizing that they can

achieve success with their personal effort and control, and feeling inner satisfaction by rewarding their success with various reinforcers.

There were 19 positive and 5 negative items in the scale. Students were asked to mark the most appropriate option, which would be equal to minimum one and maximum five for each item. The reliability coefficient of the Attention-Relevance sub-dimension of the scale was .79 and the reliability coefficient of the Confidence-Satisfaction sub-dimension was .69. The reliability coefficient obtained from the overall scale was .83.

2.3.2. Cognitive Load Scale

We used the Cognitive Load Scale developed by Dönmez et al. (2022) to reveal the cognitive load levels of the pre-service teachers in the activities carried out during the course. The 5-point Likert scale consisted of 13 items with three dimensions: Intrinsic Cognitive Load, Extraneous Cognitive Load and Germane Cognitive Load. The Intrinsic Cognitive Load dimension of the scale measures learner's cognitive load against the complexity of learning materials based on interaction during the learning process. The Extraneous Cognitive Load dimension includes items related to learning goals that cause the mind to be wasted with unnecessary information. The Germane Cognitive Load dimension includes items related to the creation of schemas for new knowledge structures during the basic processing of information.

There were nine positive and four negative items in the scale. For each item, students were asked to select five if it was the most appropriate for them and one if it was not appropriate at all. The mean value range of the scale items shows that the cognitive load level is "1-1.79 = very low", "1.80-2.59 = low", "2.60-3.39 = medium", "3.40-4.19 = high" and "4.20-5.00 = very high". The reliability coefficient of the intrinsic cognitive load sub-dimension of the scale was .87, the reliability coefficient of the extraneous cognitive load dimension was .81 and the reliability coefficient of the germane cognitive load dimension was .82, and the overall reliability coefficient of the scale was .88.

2.3.3. Semi-structured Interview Form

Within the scope of the research, we conducted semi-structured interviews with six teacher candidates selected from the experimental group at the end of the application process. The researchers prepared a semi-structured interview form and included fourteen questions

designed for visuality and feedback about the current and future use of dynamic mathematics learning objects, in order to shed deep light on their views and experiences of the process.

2.4. Data Analysis

We used descriptive analysis, dependent group t-tests, and content analysis in analyzing the data, and the data were analyzed based on the sub-problems of the study. Since the data obtained in the investigation had a normal distribution and met the assumptions of parametric tests, we used parametric tests to analyze the data. For the quantitative aspect of the research, the t-test for dependent groups was used. For the qualitative aspect of the research, we used content analysis to summarize the data from the interviews held with the pre-service teachers at the end of the implementation. Content analysis is an inductive method of analysis based on coding that reveals previously unknown facts underlying the data obtained (Pashakhanlou, 2017). With this type of analysis, data with similar meanings are coded and framed within specific themes and interpreted in a way that the reader can comprehend (Yıldırım & Şimşek, 2013). In the analysis of the data, the data were grouped according to the sub-problems. In the data processing stage, we created codes through content analysis, determined categories to explain the created codes at a general level, and coded students as S1, S2, ... S6, with direct quotes provided. In order to ensure reliability between coders, one researcher firstly analyzed the data and then another researcher analyzed the data to create a common category and code structure.

3. Results

This section includes statistical analysis of the collected data and interpretations of the findings. The findings were presented according to the research questions.

3.1. The Impact of DMLOs on the Motivation of Experimental Group Students

The results of the dependent groups t-test, used to determine whether teaching mathematics with DMLOs has a significant impact on pre-service teachers' motivation were given in Table 2.

Table 2.
Descriptive Analysis Related to Instructional Materials Motivation Scale

	Test	N	M	SD	df	t	p	d
Attention-Relevance	**Pre-Test**	24	2.93	.47	.23	-5.010	.000	.46
	Post-Test	24	3.53	.68				
Confidence-Satisfaction	**Pre-Test**	24	2.98	.56	.23	-5.896	.000	.61
	Post-Test	24	3.73	.41				

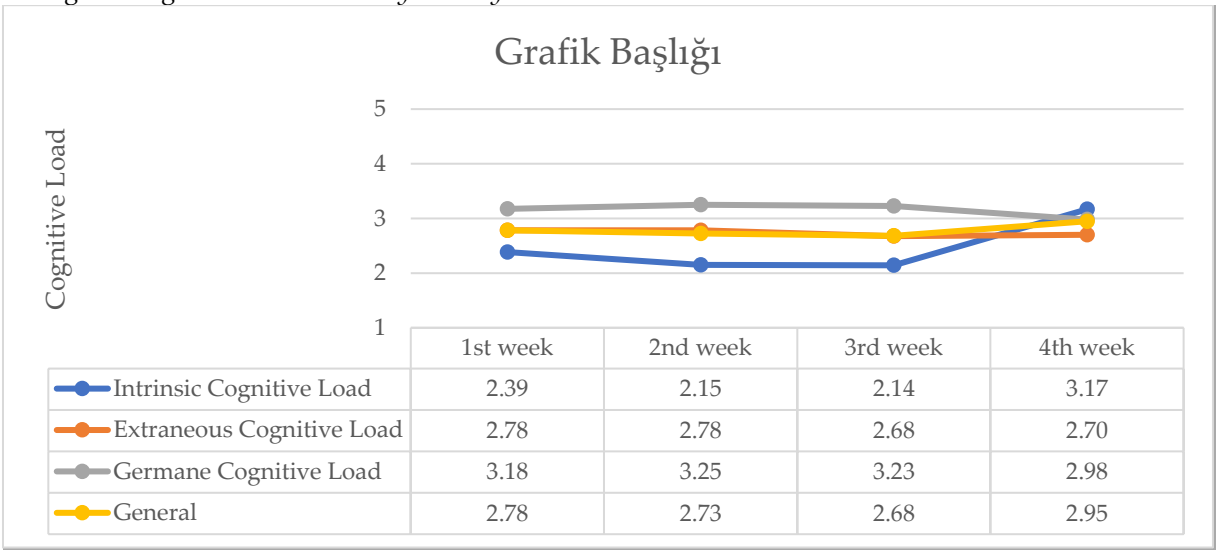
Analysis of Table 2 showed that there was a significant difference ($p<.05$) between the pre-test and post-test scores of pre-service teachers in the experimental group from the Instructional Materials Motivation Scale, in both sub-dimensions. In the sub-dimension "Attention-Relevance", mean post-test scores of the experimental group from the Instructional Materials Motivation Scale (M=3.53) were significantly higher ($p<.05$) than their pre-test scores (M=2.93). In the "Confidence-Satisfaction" sub-dimension, the mean post-test scores of the experimental group from the Instructional Materials Motivation Scale (M=3.73) were significantly higher than their mean pre-test scores (M=2.98; $p<.05$).

According to the "effect size" developed by Cohen (1988), which indicates whether the difference between the results of the groups in a study is significant or not, the value of the impact size is considered low at 0.20 low, average at 0.50, and high at 0.80. In the case of sub-dimensions, the Cohen's d effect value in the attention-relevance sub-dimension of the study conducted as a pre-post-test was (d=.46) while the Cohen's d effect value in the confidence-satisfaction sub-dimension was (d=.60). On the basis of this result, we found that the difference between the mean scores of the pre-post tests of the "Attention-Relevance" sub-dimension of DMLOs used in the teaching of integral, a math subject chosen for the application process, had a significant impact close to the mean level in real life. For the confidence-satisfaction sub-dimension, the difference between the means of the pre-post tests had a significant effect at the mean level in real life.

3.2. Cognitive Load levels of Pre-service Teachers

To investigate the impact of teaching mathematics with DMLOs on pre-service teachers' cognitive load, we applied a cognitive load scale to them each week, and the results were reported. The use of DMLOS in mathematics instruction by week and cognitive load scale subdimensions of pre-service teachers and overall scale means were shown in Figure 4.

Figure 4.
Change in Cognitive Load Level by Weekly



Analysis of Figure 4 shows that pre-service teachers' intrinsic cognitive load was low in the first three weeks and medium-high in the fourth week. The germane and extraneous cognitive load was at a medium level from the first week to the last week. As instruction with DMLO continued, the general average of the cognitive load scale was at a medium level throughout all weeks. The weekly averages of the pre-service teachers' responses to the scale items in the experimental period were presented in Table 3.

Table 3
Average of Cognitive Load Scale Items by Weeks

Items	1st Week	2nd Week	3rd Week	4th Week
1. I already knew a few things on this topic. **	2.50	2.14	2.10	3.50
2. I was familiar with the topic. **	2.00	1.95	1.71	4.08
3. My previous knowledge helped me understand the topic. **	2.79	2.45	2.81	3.29
4. The topic was quite strange to me.	2.33	2.05	1.95	1.79
5. Language of instruction was rather vague in this course.	2.71	2.82	2.62	2.92
6. During the course, I could not decide where to focus.	3.04	2.95	2.38	2.88
7. Supplied instructions / explanations were not adequate in this course.	3.08	2.82	3.38	2.92
8. The course environment was unfamiliar to me.	2.63	2.64	2.33	2.42
9. Crucial parts of the course were not clear.	2.46	2.68	2.67	2.38
10. Communication of the course enhanced my desire to learn.	3.25	3.23	3.14	3.17
11. I followed the course with pleasure.	3.04	3.18	3.24	3.17
12. Delivery of the course helped me focus.	3.00	3.36	3.14	3.00
13. I did not find the course interesting. **	3.42	3.23	3.38	2.58

** Marked items were reverse scored.

Table 3 shows that with respect to courses using DMLOs, pre-service teachers had some knowledge in the first week, and previous knowledge facilitated learning and the subject was not unfamiliar to them. In the following weeks, their familiarity with the subject increased, prior knowledge facilitated learning even more and the subject was not unfamiliar. On this basis, it can be argued that pre-service teachers learn the subject easily by using DMLOs and their cognitive load levels decrease.

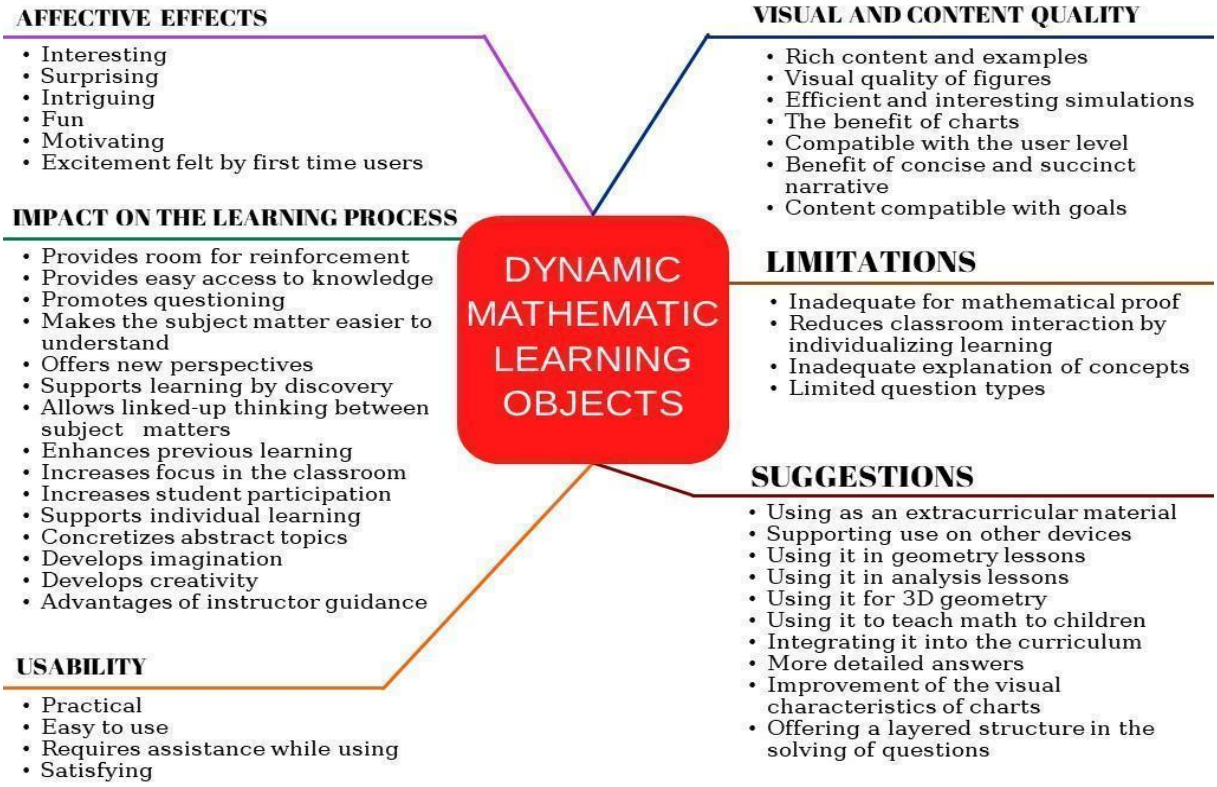
We also established that the mean score of the pre-service teachers from the scale items, were close to each other from the first week to the last week of the application, depending upon the narration of the subject matter, language of expression, focusing on important places and lesson environment when teaching with DMLOs. Therefore, cognitive load levels were also close to each other in this context. The mean score of the pre-service teachers from the scale items from the first week to the last week of the application was at a medium level with respect to the fact that teaching with DMLOs increases the desire to learn, to remain focused throughout lessons and makes them more interesting. In this context, it can be argued that the cognitive load levels were close to each other at a medium level.

3.3. Opinions and Experiences of the Pre-service Teachers

We held semi-structured interviews with six pre-service teachers (3 males and 3 females), randomly selected on a voluntary basis from the experimental group, in order to determine their views on DMLOs. Semi-structured interviews consisting of fourteen questions about their general impression of the process, the tools' impact on motivation and cognitive load were conducted with pre-service teachers who studied using DMLOs. The categories and codes formed in relation to pre-service teachers' general views on the use of DMLOs in mathematics education were shown in Figure 5.

Figure 5.

Opinions about the Use of DMLOs in Mathematics Education



An analysis of Figure 5 as well as the categories and codes indicate that pre-service mathematics teachers view the use of DMLOs in mathematics instruction from different perspectives. Within the context of their opinions, we created categories such as “Affective Effects,” “Ease of Use,” “Visual and Content Quality,” “Impact of DMLO on the Learning Process," “Limitations,” and “Suggestions”. The codes and the pre-service teachers’ statements belonging to the categories are presented in detail below. Regarding the category of affective effects, we found that pre-service teachers found DMLOs appealing, fascinating, entertaining, and motivating. Below are listed some of the statements:

> S1: "It enabled us to bone upon our previous learning, it was good, it aroused curiosity in me."
>
> S2: "Integral was a subject we had already studied in high school. I was very surprised to study it with a computer for the first time."
>
> S3: "It was fun to encounter different examples while increasing and decreasing numbers."

S2: "Making a difference in the classroom has always been effective with students. The use of such materials via computer had a positive effect on my motivation towards the lesson."

Regarding the usability category, pre-service teachers found the DMLOs useful, easy to use, satisfying while needing help to use them. Below are some of the statements in this context:

S1: "It was very well to use, I did not encounter any problems."

S4: "It was easy to use, even though I'm not very computer literate."

S2: "What the teacher conveyed to us with these materials was very productive."

S6: "I really liked increasing and decreasing the values in the question."

Regarding the visual and content quality category, pre-service teachers found that DMLOs offered rich content and examples, referring to visual quality of the figures, simulations being efficient and interesting, usefulness of charts, suitability to the user level, concise and succinct narrative, and the content being suitable for the objectives. Below are some of the statements in this context:

S2: "The material was very good, there were so many examples to reinforce learning. I also found the shapes and figures interesting."

S5: "I liked the charts and drawings, and I liked studying the changes in charts by increasing and decreasing the numbers. I enjoyed observing the changes with numbers."

S5: "It attracted my attention because the explanation of the materials was kept short."

S4: "It was very suitable for university students. I can say that I learned a lot from the material."

Regarding the category of its impact on the learning process, pre-service teachers found DMLOs useful in terms of providing reinforced learning, providing easy access to information, supporting inquiry-based learning, facilitating understanding of the subject, providing different perspectives, supporting learning by discovery, enabling to draw links between subjects, expanding previous learning, increasing attention span in the class, increasing

participation, supporting individual learning, concretizing abstract information, promoting imagination, developing creativity and providing instructor guidance. Below are listed some of the statements in this context:

> S1: "It made me refresh my previous learning, it was good, it aroused curiosity in me."
>
> S4: "Because I first tried to understand things myself in this process, it was an efficient learning process with the teacher's support on this subject, based on me being allowed to question things when learning."
>
> S5: "Computer assisted instruction was very effective in terms of providing new information and helping me better understand chart reading, which I lacked, and understanding the subject matter."
>
> S3: "There was no brainstorming in the classroom environment, everyone seemed to be working individually."
>
> S6: "I think it is necessary to use because it makes abstract information in mathematics concrete through charts."

Regarding the category of limitations, pre-service teachers found the DMLOs inadequate for mathematical proofs, reducing in-class interaction by individualizing learning, offering insufficient conceptual explanations, and limited question types. Below are listed some of the statements in this context:

> S1: "It is difficult because it is not known where the proof comes from. It's not clear what comes from where."
>
> S3: "Disadvantage of it is.. I think that if it is used continuously in the education process, everyone might become withdrawn in the classroom environment."
>
> S2: "There was not much descriptive explanation, this would be a disadvantage for someone who does not know the subject."

Regarding the suggestions category, pre-service teachers made a number of suggestions with respect to the utilization of DMLOs, including their use as an extracurricular material, supporting their use on different devices, using them in geometry and analysis lessons, and for 3D geometry subjects, using them in teaching mathematics to children, integrating them into

the curriculum, making the answers more detailed, improving the visual features of the charts, and providing a progressive structure in solving the questions. Below are listed some of the statements in this context:

> S3: "It was not of a sort that would keep the students very engaged, I think it would be good to use it in their free time."
>
> S5: "It would be a lot better if the answers had been formulated more clearly."
>
> S2: "It would be better if these materials were presented to support formal education. It would have been better if the integral was taught first as part of the regular curriculum and then these materials were used."

4. Discussion and Conclusion

The objective of this study was to determine the impact of the use of DMLOs on pre-service mathematics teachers' motivation and cognitive load in the teaching of integral, which is a subject of mathematics, and to reveal their views on the application. We presented the findings obtained under different headings for each research question, interpreted them and related them to other studies in the literature.

4.1. The Impact of the Use of DMLOs on Pre-service Teachers' Motivation

We found that pre-service mathematics teachers in the experimental group were a lot more motivated, having studied with DMLOs, in comparison to their prior motivational levels. We concluded that the use of DMLOs in the classroom environment increased their motivation towards mathematics. As a matter of fact, the qualitative findings also revealed that they found the use of DMLOs interesting, intriguing, motivating and fun as regards the affective effects of DMLOs. The fact that DMLOs are full of content and elaborate examples, provide a simulation environment, and are easy and convenient to use had a positive impact on pre-service teachers' motivation. There are also other studies that support this finding (Badeleh, 2017; Ben-Abu & Kribushi, 2022; Khoza & Biyela, 2019; Gurevich vd., 2017).

Considering the findings of the study in the context of the sub-dimensions of the instructional materials scale, we found a significant difference between pre and post DMLO pre-service teachers' motivation scores in the attention-relevance sub-dimension. We also found that the attention-relevance sub-dimension had a moderate effect on their motivation. DMLOs used

throughout the process were different from the usual teaching methods for students and ensured student participation (Golezani & Gülcü, 2021). Pre-service teachers found the visual charts of DMLOs, adapted to learning content, interesting and so used them satisfactorily (Coştu & Aydın, 2009; Wijaya vd., 2020; Kikas vd., 2020). The qualitative findings of the study also showed that they focused on the lesson better while using DMLOs in mathematics teaching and they found it fit for purpose. In the confidence-satisfaction sub-dimension, we found a significant difference between pre and post motivation scores. We found that the confidence - satisfaction sub-dimension had a moderate impact on pre-service teachers' motivation. The fact that the DMLOs were designed in accordance with the curriculum and that there were exercises and practice questions increased student confidence that they would succeed in this course (Hangül & Üzel, 2010). Presenting the subject content in an understandable way facilitated the learning of the course. Considering the pre-service mathematics teachers' opinions in this context, the association of topics with previous learning facilitated learning and provided reinforcement.

Pre-service teachers who used DMLOs in mathematics teaching were highly motivated, had a positive attitude towards technology and made less effort during the implementation process. We found that pre-service teachers who used DMLOs were inclined to use such tools in their future professional lives and were satisfied with the application. We also noted that learning mathematics using DMLOs increases motivation, and that students enjoy using them and have a positive attitude towards them (Murray & Rabiner, 2014; Schmidt & Vandewater, 2008).

4.2. The Impact of the Use of DMLOs on Pre-service Teachers' Cognitive Load Levels

In this study, computer-supported DMLO represented education-technology integration. We analyzed the cognitive load levels of the pre-service mathematics teachers who studied with DMLOs weekly during the implementation process and found that their cognitive load levels were close to each other and moderate. Looking at the cognitive load in terms of sub-dimensions we concluded that the intrinsic cognitive load sub-dimension was at a low level in the first three weeks, while it was at a medium level in the last week, the extraneous cognitive load sub-dimension was close to a low level throughout the application process, and the germane cognitive load sub-dimension was at a medium level throughout the application process. This result corroborates Sweller (2020) who concluded that media elements such as

computers, television, digital games and technology had an impact on cognitive load in the learning process. Learning is easier when both verbal and visual components are used together in the teaching environment (Dinç, 2019; Skulmowski & Xu, 2021). Presenting stimuli such as text and pictures together when it comes to the arrangement of instructional materials enables the use of both channels in working memory. Some studies on computer-assisted learning (Mcgarr & Johnston, 2021; Hu et al., 2019; Sánchez-Pérez et al, 2019) show that two different sources of information do not benefit learning when they are not appropriate for the instructional goal or when they do not facilitate understanding of each other. Attracting students' attention or making them interested in the lesson are considered as important variables in learning. However, it should not be forgotten that the aim of teaching should be to direct the student's interest and attention to the intended learning content rather than to any subject. Looking at the opinions of students regarding cognitive loads with respect to using computer-supported DMLOs in mathematics teaching, quantitative findings support the conclusion that software with a graphical interface facilitates learning and that it is useful to explain the target content in a short and concise way through DMLOs.

4.3. Pre-service Mathematics Teachers' Opinions on the Use of DMLOs

In respect of pre-service mathematics teachers' opinions about the use of DMLOs in mathematics teaching, they had different opinions when it came to their use in the classroom. The reason why pre-service teachers had different opinions was that the individual use of DMLOs had different impacts on pre-service teachers and the use of technology in the educational environment was perceived differently. In addition, in the context of someone using a computer for the first time in the learning process, pre-service teachers were interested in and curious about the use of DMLOs in the educational environment. In support of this finding, Jaakma and Kiviluoma (2019) found that mechanical computer-aided materials attracted students' attention. Regarding the usability of CAI tools, they are easy to use and the help of an instructor is needed while using them. This can be explained by the fact that while using DMLOs in mathematics education, instructor support is needed to explain some formulas.

When we look at the impact of DMLOs on the learning process, there are quite different opinions. Especially in mathematics education, the use of such materials in transferring abstract

knowledge is very important for the learning process (Gozelani & Gülcü, 2021). In particular, supporting individual learning and students receiving tutorial support are efficient in terms of gaining abstract knowledge (Aydoğdu et al., 2014; Zengin, 2015). Regarding the visual components and content quality of the DMLOs, pre-service mathematics teachers' opinions show us that multiple learning environments have a significant impact on learning. The fact that the charts used were congruous with the subject matter as a whole and presented in a way to summarize the subject provided satisfaction in terms of use. In addition to the benefits of using DMLOs in mathematics teaching, they also have some limitations for students. In particular, the presence of conceptually inadequate explanations in proving some formulas is considered a limitation for students. Looking at the opinions of students about the use of DMLOs in mathematics education, they recommend their use especially in geometry lessons. Apart from computers, it is also recommended to use them on smart devices such as mobile, tablet, etc. (Hung, 2015; McGivney-Burelle & Xue, 2014).

4.4. Conclusion and Recommendations

This mixed-method study, conducted to examine the impact of using DMLOs in mathematics education on pre-service teachers' motivation and cognitive load, also has some limitations. Among the limitations of the study was the fact that the quantitative part of the study was designed as a one-group pretest-posttest experiment, with a limited sample size. In addition, the fact that the pre-service teachers used the DMLOs only during the course was another limitation of the study.

On the basis of the results of the study, we concluded that the use of DMLOs in teaching the subject matter of integrals was found easy by the pre-service teachers, and that dynamic charts had a positive impact on their motivation levels and kept their cognitive load averages at an optimal level. In this context, it is recommended to repeat such studies with other mathematics subjects containing abstract concepts, besides integral. We concluded that DMLOs had a medium size effect on pre-service mathematics teachers' motivation. The study can be repeated over a longer period and using a larger sample to re-examine the dimension of motivation. In future studies, the impact of DMLOs on pre-service teachers' achievement, motivation and problem-solving skills can be investigated by using them for a longer period of time in advanced mathematics and geometry courses. Experimental studies can be conducted to

examine their effects on students' cognitive load comparatively. DMLOs can be offered to higher education students taking mathematics courses in different departments of universities. In addition to regular teaching, it may be useful to ensure the use of DMLOs as extracurricular materials through mobile devices. We suggest that material design courses should include topics on the development of such applications so that pre-service teachers can use these types of DMLOs in their future careers. In-service professional development training can be offered by the relevant units in universities for faculty members working in mathematics departments to design and use such applications in their courses.

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ITALL

Research Article

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Investigation of Mobile Applications for Children to Support the Acquisitions in the Preschool Education Program

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Abstract

Nowadays, with the widespread use of mobile devices and the internet, the age range of users has decreased to the preschool period. Games in application stores do not always contain educational content. The content encountered is important for children who spend some of their time playing games on mobile devices. In line with this, the present study aimed to examine the support status of mobile applications for children regarding the acquisitions in the Preschool Curriculum. The sample of the study, in which the document analysis method was employed, consists of 24 mobile applications for children in the Google Play Store. While examining the applications, the data were processed into the Application Review Form created on Google Forms by the researcher, and all the data were analyzed at the end of the review process. According to the study results, it was revealed that the examined mobile applications could support 28 acquisitions out of a total of 63 acquisitions in the Preschool Curriculum and the highest number of supportable acquisitions belonged to the cognitive development domain. It was concluded that mobile applications were insufficient to support the acquisitions in other development domains and mobile applications could be used as an educational tool only for some acquisitions, and suggestions were presented in this direction.

Keywords: Preschool Education Program, Mobile Application, Mobile Device, Acquisition

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Çocuklara Yönelik Mobil Uygulamaların Okul Öncesi Eğitim Programında Yer Alan Kazanımları Destekleme Durumunun İncelenmesi

Özet

Günümüzde mobil cihazlar ve internet kullanımının yaygınlaşmasıyla kullanıcı yaş aralığı okul öncesi döneme kadar inmiştir. Uygulama marketlerinde yer alan oyunlar ise her zaman eğitsel içerikler barındırmamaktadır. Zamanlarının bir kısmını mobil cihazlarda oyun oynayarak geçiren çocuklar için karşılaştıkları içerikler önem arz etmektedir. Bu doğrultuda bu çalışmada, çocuklara yönelik mobil uygulamaların Okul Öncesi Eğitim Programı'nda yer alan kazanımları destekleme durumunun incelenmesi amaçlanmıştır. Bu araştırmada nitel araştırma desenleri arasında yer alan doküman incelemesi kullanılmıştır. Çalışmanın örneklemini Google Play Store'da bulunan çocuklara yönelik 24 adet mobil uygulama oluşturmaktadır. Uygulamalar incelenirken veriler araştırmacılar tarafından Google Formlar üzerinde oluşturulan Uygulama İnceleme Formu'na işlenmiş, inceleme sürecinin sonucunda ise tüm veriler analiz edilmiştir. Araştırmanın sonucuna göre incelenen mobil uygulamaların Okul Öncesi Eğitim Programı'nda yer alan toplam 63 kazanımdan 28 kazanımı destekleyebileceği ve en çok desteklenebilecek kazanımların bilişsel gelişim alanına ait olduğu tespit edilmiştir. Mobil uygulamaların diğer gelişim alanlarındaki kazanımları destekleme durumunda yetersiz kaldığı, mobil uygulamaların ancak bazı kazanımlara yönelik eğitim aracı olarak kullanılabileceği sonucuna ulaşılmış ve bu doğrultuda öneriler sunulmuştur.

Anahtar Kelimeler: Okul Öncesi Eğitim Programı, Mobil Uygulama, Mobil Cihaz, Kazanım

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1. Introduction

Many different definitions have been made about education given its broad scope and dynamic structure. The elements it contains vary based on its underlying philosophy and the expectations toward it can also change (Yavuz, 2018). According to Ertürk (1972), education is the process of intentionally achieving a desired change in an individual's behavior through his/her own experiences. In other words, education is the process of planned changes in an individual's behaviors by practising and experiencing, determined by societal ideals (Gürsel, 2003; cited in Yavuz, 2018). According to Başaran (1994), the aim of education is to individualize one and make him/her productive while fostering cultivation and socialization.

Although education continues throughout life, formal education consists of stages limited to certain ages. Preschool education, which covers the 0-6 age range of formal education, aims to support all areas of development, considering individual differences among children, to provide children with a stimulating environment, to instill cultural values, and to prepare them for primary school (Katrancı, 2018). In line with these objectives, in the preschool education program in Turkey, the outcomes that children should reach in various developmental areas are referred to as acquisitions, while their observable forms are referred to as indicators. The preschool education program includes 22 acquisitions in the field of cognitive development, 12 acquisitions in language development, five acquisitions in motor development, 17 acquisitions in social-emotional development, eight acquisitions in self-care skills, each with related indicators (Ministry of National Education [MoNE], 2013).

When planning their education, preschool teachers take into account the developmental levels of their students, select acquisitions, indicators and concepts in the program in accordance with the interests, needs and environment of their students, thus incorporating them in their education plan. The goal is to teach these acquisitions and concepts by using various types of activities in the preschool education program. These activities include Turkish language, art, drama, music, movement, play, science, mathematics, literacy preparation, and field trips (MoNE, 2013).

Preschool teachers integrate technology into their activities, considering the contemporary age, not only when planning their activities but also when implementing them in the classroom environment. Examples of technological tools used by teachers include computer, Internet,

television, projection, smart board, etc. These tools provide advantages to both teachers and students in terms of diversity, convenience, and easy access to data (Can-Yaşar et al., 2012). Technology is an integral part of life, and it is vital to educate individuals who use technology effectively in education, as in every field, and to provide technology integration for achieving this goal (Uslu & Özgün, 2023). However, learning can be increased to higher levels through enriching learning environments with technology and integrating these technologies into education programs (Avcı & Candan, 2023).

In the current state of technology, mobile devices hold a significant position in human life. Mobile devices and the Internet have facilitated communication and accelerated access to information. Likewise, children are introduced to mobile devices at an early age and generally use mobile devices for playing games and watching videos (Kol, 2021). For children, technology can serve as a toy or learning tool (Tüzel İşeri, 2018). However, the unconscious use of mobile devices, starting to use it as early as two years old, and problems with content and timing, there are concerns that technology can cause more harm than benefit to children. In this regard, families find the solution in completely preventing children from using mobile devices and keeping them away from technology. However, this approach is not feasible given the increasing prevalence of technology in daily lives of children. In this consideration, families should be aware of the issue and guide their children, ensuring that they use technology properly and obtain the maximum benefit from it (Budak, 2020).

Today, mobile devices, equipped with features and capacities of a computer, are used as educational tools in higher education with the advantages they offer. Their integration is also expected in other substages of education in the future. Mobile devices are integrated in the education process for various reasons, such as portability, capacity to present diverse content in different ways, and the ability to interact with the content through visual, audible and touchscreen facilities. In the future, they may be favored in terms of allowing students to be engaged in the education process outside the school. Another technological element thought to be important in the future is digital games. Within the scope of digital games, which have become independent of borders as they are in a virtual environment, players can collaboratively solve problems and develop various skills. Digital games can have numerous educational benefits and be used as educational tools. It is argued that this can only happen through educational digital games designed for curricula and educational purposes (Bardakçı, 2018).

Because development and learning are quite rapid and self-control has not yet developed in the preschool period, the type and duration of use of technological devices in children's life in this period is crucial. Digital games, which attracts children's attention and can become a very attractive educational tool for them when used correctly, are also defined as natural teachers (Gölge, 2022). Similarly, parents providing mobile devices to their children while doing housework or traveling believe that their children can benefit from educational mobile applications (Göle, 2023). For mobile applications to serve as natural teachers, they are expected to align with the preschool education program. This shapes the education that preschool children receive in educational institutions. Preschool children who are familiar with and use mobile devices in the preschool period can derive educational benefits if the mobile applications they use for preschool children align with the preschool education program.

In this sense, a question arises regarding whether mobile devices can serve as educational tools, and therefore, whether mobile applications can be utilized as educational tools. For mobile applications to be deemed appropriate for use in preschool education, they should be oriented toward learning acquisitions in the preschool education program. The present study seeks to examine the suitability of mobile applications for acquisitions in the preschool education program.

1.1. Significance of the Research

With the development of technology, access to technological devices is increasing. Today, we can access the desired data on the Internet using smartphones and tablets. According to a study by the Turkish Statistical Institute, the proportion of households with access to the Internet increased by 1.3% in 2021 compared to the previous year and reached 92.0% (Turkish Statistical Institute [TURKSTAT], 2021). Adults' easy access to and continuous interest in the Internet and mobile devices may cause children to access and be interested in them in the same way. In addition, constant flow of visuals, lights, and sounds attract children's attention (Urfa, 2020).

One of the most important factors in preschool education is family. Children experience their first learning experiences with their families. Family support holds a very significant place throughout the education process. The engagement of families in the preschool period can affect children's both academic and social, emotional, and self-development in several ways.

Conversely, the absence of family involvement may lead the child to feel a deficiency in many ways (Ergüden et al., 2020).

In a study conducted with parents, technology addiction emerged as one of the problems they experienced concerning their children. They expressed a desire for receiving parental education as support for educational guidance (Koç et al., 2022). In the study conducted by Durmuş and Övür (2021), 30.2% of the children encountered smartphones at the age of 7-12 months and 18.24% encountered tablets at the age of 25-36 months. In this study, 33.1% of the children spent 0-1 hour a day with smartphones and 20.3% spent 0-1 hour a day with tablets, with 47.3% watching videos on smartphones.

The influence of parents is very important in children's interactions with mobile devices. Parents provide their children with the opportunity to engage with applications by installing applications designed for children from application markets on their devices. However, improperly selected applications and misuse can lead to addiction in children. There are children who cannot meet even their basic daily needs without mobile devices. Because children are more vulnerable at their age and lack sufficient usage skills, the Internet poses various risks for them. These risks can range from encountering inappropriate content to exposing personal information. Thus, parents with Internet literacy can provide effective guidance to their children on safe Internet practices. This support includes protecting children from various risks and guiding them on proper Internet use (Kopuz et al., 2022). It is very risky for children to spend time with mobile devices with Internet connections without parental supervision. Therefore, regarding the use of mobile devices, particularly for preschool children, the applications and content used, the time spent and the purposes of use are crucial. With these limitations imposed on children, we can talk about benefit rather than harm (Kol, 2021). Parents typically do not have restrictive attitudes toward mobile devices, and even those who do may permit their usage in certain circumstances. Children whose parents are generally inadequate in supervision can use mobile devices to access both content and applications without supervision, often without their parents' knowledge (Cengiz Saltuk & Erciyes, 2020). With the provision of education through digital media during the COVID period, parents do not have the necessary knowledge and skills to guide their children correctly and need guidance to access the right resources and methods (Cao et al., 2022). Some parents find digital technology frightening for their children, while others introduce it to them at an earlier age than they

should. However, parents should be aware of the possible dangers in the digital world, protect their children from these dangers, raise awareness of their children against them. They should further ensure that their children can access and benefit from the right and safe content without any problems, just as they protect and guide them in the real world (Kurtoğlu Erden & Uslupehlivan, 2021). Today, the number of mobile applications that appeal to children, offered to them as toys by their parents, is increasing daily. Various mobile applications produced at this point generally aim to attract children's attention and entertain them. Some applications have the purpose of providing educational content. In this respect, there are some criteria that mobile applications, which are inevitably used in the education process, must meet to be considered educational. Examples of these criteria include the appropriateness of the child's developmental characteristics as well as the presence of hardware features that can be used, the presence of explanatory and directive instructions for the application, the opportunity to make mistakes, the difficulty level being adjustable according to children, the use of interesting vivid colors and visuals that facilitate understanding, the examination of the app's advertisements, etc. (Topuz & Kaptan, 2017).

A study examined the information exchange of preschool teachers about the use of mobile applications in education on an online platform. It found that teachers wanted to include applications in the educational process for different educational purposes. A preschool teacher emphasized that it is not impossible for a competent preschool teacher to turn mobile devices, which act as a babysitter, into educational tools. Any object unrelated to education can be turned into a usable tool in education with the necessary adjustments made by the teacher (Marklund & Dunkels, 2016).

In light of this information, when determined that mobile applications for children are compatible with and support the acquisitions in the preschool education program, this can benefit three groups. Children who spend a lot of time with mobile devices and are exposed to content and applications that may not be age-appropriate can have fun and learn by using applications that are appropriate for their development and support the learning acquisitions in their education. Preschool teachers seeking to engage families in education and care about children using more appropriate applications on mobile devices can recommend families to use these applications with their children as an alternative. In addition, the teacher can make use of the applications in the classroom, even if limited, and turn them into educational tools.

1.2. Aim of the Research

In this study, we aimed to examine the extent to which mobile applications for children support learning acquisitions in the preschool education program. Within this framework, we sought answers to the following questions:

1. *To what extent do mobile applications for children support the acquisitions in the preschool education program?*
2. *Which acquisitions from the preschool education program supported by mobile applications for children are most supported by the applications?*
3. *Can mobile applications for children be a training tool for preschool teachers and a support training tool for families based on their ability to support the acquisitions in the preschool education program?*

2. Method

This section provides information about the research model, population and sample, data collection tools, data collection, and data analysis.

2.1. Research Model

This study employed document analysis, one of the qualitative research designs, to determine the extent to which 24 applications suitable for ages 5 and younger among the applications under the title of "education" in the "children" category of the Google Play Store, meet the acquisitions based on the developmental areas in the preschool education program. Document analysis is a qualitative research method used to examine, evaluate, and interpret the content of written documents in detail and to systematically generate understanding and make sense of the subject (Corbin & Strauss, 2008; Wach & Ward, 2013; Yıldırım & Şimşek, 2016). In this context, the children's applications in the Google Play Store were examined within the framework of the acquisitions in the preschool education program, evaluating the suitability of the applications to the acquisitions. Because the research involves the evaluation of the applications in the Google Play Store by experts based on the application review form, Ethics Committee permission was not necessary.

2.2. Population and Sample of the Study

The population of the study consists of all applications in the Google Play Store. As a sample in the study, 24 applications that were randomly selected from the applications under the title of "education" in the "children" category in the Google Play Store, which are suitable for ages 5 and younger, and the applications that are close to this category from the applications found by searching with the keywords "preschool" and "preschool games" were examined. Applications that did not have educational content and were difficult to understand were not included in the study.

2.3. Data Collection Tools

To facilitate data recording and analysis, the researchers created an application review form on Google Forms with the guidance of an expert. The data related to the implementation were recorded on this form. The form included eight sections. The first section covered the application name, the recommended age group, the purpose of the application, the platform the application was located on, whether there were in-app purchases, the existence of advertisements in the application, the ratings it received from users, download statistics, and whether it was in the teacher-approved category. The other five sections of the form consisted of acquisitions based on the development areas outlined in the preschool education program. These development areas included cognitive development, language development, social and emotional development, motor development, and self-care skills. The seventh section of the application included the categorization made by Google Play about the application. It encompassed the age range for which the app was suitable, indicated which area it was educational in, if in the educational category, subheadings in the fun and interesting category, subheadings in the specially designed for children category, subheadings in the creativity and imagination category, positive messages it contained, and the labels it had in Google Play labeling. The final part of the form included a summary of user comments about the app and the researchers' comments. Additionally, there was an item stating that the application could support the identified acquisitions when used under the guidance of an adult speaking English.

2.4. Data Collection Process

Following the literature review, mobile applications were installed on a mobile device. Prior to examining the application, sections 1 and 7 of the application review form were filled in

considering the page of the respective mobile application on Google Play. Then, each mobile application was examined starting from step 1, examining each step or category. While examining the application, the acquisitions in the preschool education program were considered and the compliance of the applications with these acquisitions was analyzed. Subsequently, the data were entered into the implementation review form as necessary. Then, the final section of the application review form was filled in as per the reviews and user comments and this process was renewed for each application. In addition, notes were taken to briefly summarize the ways in which the applications supported the identified acquisitions.

Each mobile application is produced by different application developers for different purposes. While some developers aim to create a truly useful and educational application for children, others can be more concerned with materialistic concerns. It is not possible to know these purposes. Therefore, the applications were selected relying on the purposes stated by the developers. During the research, a form was created to analyze the data of the applications. In line with the data and labeling in Google Play, new sections were created by adding them to the form. In addition, after noticing the "teacher approved" labeling in certain applications in the children category by Google Play, an inquiry was conducted to ascertain the certain features for receiving these labels. In addition, a new section was added to the form for this category, aiming to determine the effect of this labeling on the applications' ability to support the acquisitions. It also aimed to examine more applications, but since the acquisitions in the preschool education program are comprehensive and the applications generally consist of many phases, the research was limited to 24 applications. During the research, most of the applications were in English and did not include Turkish language support. After determining that these applications could support the acquisitions if they had Turkish language support, the item "*This application can only support the stated acquisitions under the guidance of an adult who speaks English*" was added to the form.

2.5. Data Analysis

Following the examination of 24 mobile applications, the data in the responses section of the application review form created in Google Forms were analyzed. For open-ended items, the prominent answers were taken as a basis, and for optional items, the analysis was performed

by examining the graphs automatically generated by Google Forms. The analysis was conducted according to the items in the application review form.

3. Result

This section presents the findings that derived from the analysis of the data obtained from the implementation review forms.

3.1. Names of the Examined Applications

Table 1 shows the names of the 24 mobile applications for children whose compliance with the acquisitions in the preschool education program was evaluated.

Table 1.

Application Names

Application Name
TRT Aegean and Gaga
Miffy's World - Bunny Adventures
Preschool Educational Game
Montessori Preschool Games
Masha and the Bear Educational Game
Brain Games for 4-6 Year Olds: Kids Brain Teasers
Coloring Book for Children
Pinkfong Numbers Zoo
KidloLand-Children's Songs and Games
Educational games for 2-5 years - kids games
Kids Preschool Basics
Kids UP - Montessori Online
Baby Panda's Emergency Tips
Preschool Games
Baby Shark Car Town
Funny Food 2
Kid-E-Cats. Educational Games
Busy Shapes & Colors - Learn Colors and Shapes
Sago Mini Camping
Sago Mini Space
MarcoPolo Ocean
Kidzooly-Kids Preschool Learning Games & Toddler Rhymes
Sago Mini Super Juice Maker
Dino Tim

3.2. Appropriate Age Group for Applications

Table 2 shows that 18 of the 24 applications were suitable for ages 2 and above, four were suitable for ages 4 and above, and two did not specify the appropriate age. Of the applications examined, 75% were suitable for ages 2 and above.

Table 2.

Appropriate Age Group for Applications

2+ Age	4+ Age	Unspecified
18	4	2

3.3. Purpose of the Applications

Table 3 shows that 17 of the 24 applications included activities such as puzzles, painting, matching, recognizing numbers, colors, patterns, and shapes. The purpose of the applications was to perform these activities. The remaining seven applications were found to have different themes and purposes. Although 70.83% of the analyzed applications were not similar, they had similar purposes. The visuals, sounds, types of activities and games, and actions expected to be performed were similar. However, 29.17% of the applications were designed for different purposes additional to or different from the purposes of other applications. These included finding different objects from pictures that would eventually form the picture of a story, discovering and experiencing different things in a campground with animals and objects, preparing and serving fruit juices using interesting materials in different ways, accompanying a tiny rabbit for a day, exploring in a submarine and creating your own submarine, providing first aid intervention to children injured in several ways, and exploring with a dog in space.

Table 3.

Purpose of the Applications

Completing Activities such as Puzzle, Coloring, Matching	Objectives for Different Themes
17	7

3.4. Platforms of the Examined Applications

Table 4 shows that 20 of the 24 applications are available in both the Android and IOS application markets, and four are only available in the Android application market. The vast majority of the analyzed applications (83.33%) were created to be compatible with both the Android and IOS operating systems.

Table 4.

Platforms of the Examined Applications

Android + IOS	Android
20	4

3.5. Availability of Advertisements in the Examined Applications

Table 5 shows that nine of the 24 applications contained advertisements, while 15 did not. Of the analyzed applications, 37.50% contained advertisements, while 62.50% did not.

Table 5.

Availability of Ads in Examined Applications

There are Ads in the App	No Ads in the App
9	15

3.6. In-App Purchase Status in the Examined Applications

Table 6 shows that 21 of the 24 applications had in-app purchases, while three did not. The vast majority of the analyzed applications (87.50%) had in-app purchases.

Table 6.

In-App Purchase Status in Examined Applications

In-App Purchases Available	No In-App Purchases
21	3

3.7. The Number of Stars (Ratings) Received by Users in the Examined Applications

Table 7 shows that five of the 24 applications received three stars and 19 received four stars from the users in the application markets. The majority of the analyzed applications, 79.17%, received four stars.

Table 7.

The Number of Stars (Rating) Received by Users

3 Stars	4 Stars
5	19

3.8. The Number of Downloaded Examined Applications by Users

Table 8 shows that one of the 24 applications was downloaded between 5,000 and 10,000 times, one was downloaded between 10,000 and 50,000 times, two were downloaded between 50,000 and 100,000 times, five were downloaded between 100,000 and 500,000 times, one was downloaded between 500,000 and 1,000,000 times, and 14 were downloaded more than 1,000,000 times. The majority of the analyzed applications, i.e., a total of 58.33% were downloaded more than 1,000,000 times.

Table 8.

Number of Downloads by Users

5000-10000	10.000-50.000	50.000-100.000	100.000-500.000	500.000-1.000.000	>1.000.000
1	1	2	5	1	14

3.9. The Status of the Examined Applications Included in the Teacher Approved Category

Table 9 shows that 17 of the 24 applications were found in the Teacher Approved category created by the Google Play Store, while the rest were not. The vast majority of the analyzed applications, i.e., a total of 70.83% were teacher-approved applications.

Table 9.

Inclusion in the Teacher Approved Category

Teacher Approved	Not Teacher Approved
17	7

3.10. The Status of Supporting Cognitive Development Acquisitions by the Examined Applications

Table 10 indicates how many of the 24 applications can support the cognitive development acquisitions in the preschool education program. Accordingly, all applications can support acquisition one. The 2nd, 3rd, 4th, 5th, 6th, 8th, 12th, and 15th acquisitions can be supported by 10 or more applications. The 7th, 9th, 10th, 14th, 16th, 17th, 18th, and 20th acquisitions can be supported by at least one and at most nine applications. The 11th, 13th, 19th and 21st acquisitions cannot be supported by any application.

> *"In the game, blue, yellow and red chameleons are matched with food of the same color."* **(Educational games for ages 2-5 – Children's games) - 1st, 5th, 6th, and 8th acquisitions**
>
> *"In the game, the two groups of fireflies are counted and the correct number is marked after finding out their total number."* **(KidloLand-Children's Songs and Games) - 4th and 16th acquisitions**
>
> *"When an apple is dragged to the campfire, it turns into a pie. By remembering this information and using it in new situations, the child can try dragging different foods to the fire."* **(Sago Mini Camping) - 3rd acquisition**

"In the game, different geometric shapes and spaces suitable for these shapes are matched." **(Brain Games for 4-6 Year Olds: Kids Brain Teasers) – 5th, 6th, 8th and 12th acquisitions**

"In the game, creatures and tools are disassembled down to the smallest part and then reassembled to form a wholeness." **(MarcoPolo Ocean) - 15th acquisition**

"The lost tooth of the dinosaur is replaced by finding the correct color in accordance with the pattern. Then, it is brushed and whitened." **(KidloLand-Children's Songs and Games) – 1st, 5th, 8th and 14th acquisitions**

Table 10.

The Status of Supporting Cognitive Development Acquisitions by the Examined Applications

Acquisition	Number of Applications that can Support the Acquisition
Acquisition 1. S/he pays attention to the object/situation/event.	24
Acquisition 2. S/he makes predictions about the object/situation/event.	11
Acquisition 3. S/he recalls what they perceive.	10
Acquisition 4. S/he counts objects.	10
Acquisition 5. S/he observes objects or entities.	19
Acquisition 6. S/he matches objects or entities according to their properties.	18
Acquisition 7. S/he groups objects or entities according to their properties.	9
Acquisition 8. S/he compares the properties of objects or entities.	13
Acquisition 9. S/he sorts objects or entities according to their properties.	4
Acquisition 10. S/he applies the instructions related to location in space.	1
Acquisition 11. S/he measures objects.	0
Acquisition 12. S/he recognizes geometric shapes.	11
Acquisition 13. S/he recognizes symbols used in daily life.	0
Acquisition 14. S/he creates patterns with objects.	7
Acquisition 15. S/he understands the part-whole relationship.	11
Acquisition 16. S/he performs simple addition and subtraction operations using objects.	1
Acquisition 17. S/he establishes a cause-effect relationship.	1
Acquisition 18. S/he explains the concepts related to time.	1
Acquisition 19. S/he produces solutions to problem situations.	0

Acquisition 20. S/he prepares graphics with objects/symbols.	1
Acquisition 21. S/he recognizes Atatürk and explains his importance for Turkish society.	0

3.11. The Status of Supporting Language Development Acquisitions by the Examined Applications

Table 11 indicates how many of the 24 applications can support the language development acquisitions in the preschool education program. Accordingly, only the 1st, 6th and 7th acquisitions can be supported by at least one application and the other 9 acquisitions cannot be supported by any application.

> *"An animal sound is played, asking which animal it is."* **(Kids UP - Montessori Online) – 1st acquisition**
>
> *"In the game, the names of various sea creatures and tools are mentioned with their details using their visuals."* **(MarcoPolo Ocean) – 6th and 7th acquisitions**

Table 11.

The Status of Supporting Language Development Acquisitions by the Examined Applications

Acquisition	**Number of Applications that can Support the Acquisition**
Acquisition 1. S/he distinguishes sounds.	3
Acquisition 2. S/he uses her/his voice appropriately.	0
Acquisition 3. S/he constructs sentences according to syntax rules.	0
Acquisition 4. S/he uses grammar structures while speaking.	0
Acquisition 5. S/he uses language for communication purposes.	0
Acquisition 6. S/he develops vocabulary knowledge.	1
Acquisition 7. S/he understands the meaning of what he/she listens/watches.	2
Acquisition 8. S/he expresses what s/he listens/watches in various ways.	0
Acquisition 9. S/he demonstrates phonological awareness.	0
Acquisition 10. S/he reads visual materials.	0
Acquisition 11. S/he demonstrates reading awareness.	0
Acquisition 12. S/he demonstrates writing awareness.	0

3.12. The Status of Supporting Social and Emotional Development Acquisitions by the Examined Applications

Table 12 indicates how many of the 24 applications can support the social and emotional development acquisitions in the preschool education program. Accordingly, only the 3rd and 4th acquisitions can be supported by an application and 15 acquisitions cannot be supported by any application.

> *"The child can design his/her own monster image using the options offered during the game."* **(KidloLand-Children's Songs and Games) - 3rd acquisition**
>
> *"The child can express the reasons for the reactions of the animals drinking the prepared juices."* **(Sago Mini Super Juice Maker) - 4th acquisition**

Table 12.

The Status of Supporting Social and Emotional Development Acquisitions by the Examined Applications

Acquisition	**Number of Applications that can Support the Acquisition**
Acquisition 1. S/he introduces her/his own characteristics.	0
Acquisition 2. S/he introduces the characteristics of her/his family.	0
Acquisition 3. S/he expresses herself/himself in creative ways.	1
Acquisition 4. S/he explains the feelings of others about an event or situation.	1
Acquisition 5. S/he shows positive/negative feelings about an event or situation in appropriate ways.	0
Acquisition 6. S/he protects her/his own and others' rights.	0
Acquisition 7. S/he motivates herself/himself to accomplish a job or task.	0
Acquisition 8. S/he shows respect for differences.	0
Acquisition 9. S/he explains different cultural characteristics.	0
Acquisition 10. S/he fulfills her/his responsibilities.	0
Acquisition 11. S/he takes responsibility in activities related to Atatürk.	0
Acquisition 12. S/he complies with the rules in different environments.	0
Acquisition 13. S/he protects aesthetic values.	0
Acquisition 14. S/he recognizes the value of works of art.	0
Acquisition 15. S/he has self-confidence.	0
Acquisition 16. S/he explains that individuals have different roles and duties in social life.	0
Acquisition 17. S/he solves problems with others.	0

3.13. The Status of Supporting Motor Development Acquisitions by the Examined Applications

Table 13 indicates how many of the 24 applications can support the motor development acquisitions in the preschool education program. Accordingly, only the 2nd acquisition can be supported by an application and the remaining 4 acquisitions cannot be supported by any application.

> *"In the exercise section, various balance movements that children can do are provided with visuals and timings." (Preschool Games) - 2nd acquisition*

Table 13.

The Status of Supporting Motor Development Acquisitions by the Examined Applications

Acquisition	Number of Applications that can Support the Acquisition
Acquisition 1. S/he makes displacement movements.	0
Acquisition 2. S/he makes balance movements.	1
Acquisition 3. S/he performs movements that require object control.	0
Acquisition 4. S/he performs movements that require the use of small muscles.	0
Acquisition 5. S/he moves with music and rhythm.	0

3.14. The Status of Supporting Self-Care Skills Acquisitions by the Examined Applications

Table 14 indicates how many of the 24 applications can support the self-care skills acquisitions in the preschool education program. Accordingly, the 1st, 2nd, 3rd, 7th and 8th acquisitions can be supported by at least one application, while the remaining 3 acquisitions cannot be supported by any application.

> *"The character in the game is awakened by the child, showing self-care skills such as brushing teeth, bathing, and dressing."* **(Miffy's World - Bunny Adventures) - 1st, 2nd and 3rd acquisitions**

> *"The game shows different reasons for children's injuries and treatment methods. The child gives first aid to the injured children in the game."* **(Baby Panda's Emergency Tips) - 7th and 8th acquisitions**

Table 14.

The Status of Supporting Self-Care Skills Acquisitions by the Examined Applications

Acquisition	Number of Applications that can Support the Acquisition
Acquisition 1. S/he applies the rules of cleanliness related to her/his body.	1
Acquisition 2. S/he is able to do things related to dressing.	1
Acquisition 3. S/he makes necessary arrangements in living spaces.	2
Acquisition 4. S/he has an adequate and balanced diet.	0
Acquisition 5. S/he explains the importance of resting.	0
Acquisition 6. S/he uses the necessary tools and materials for daily life skills.	0
Acquisition 7. S/he protects herself/himself from dangers and accidents.	1
Acquisition 1. S/he takes precautions related to her/his health.	1

3.15. Age Appropriateness and Different Category Labelings for Teacher-Approved Applications

Table 15 indicates that eight of the 17 teacher-approved applications are suitable for ages up to five years and nine applications are suitable for age groups of 6-8 years. Among the 12 teacher-approved applications evaluated in the education category, six applications were labeled as mathematics, five applications were labeled as arts, and four applications were labeled as language arts. Therefore, these three labels were most frequently given in the education category. Music, emotional literacy, and science labels were assigned to only one app, while the social sciences label was not assigned to any app. Sixteen out of the 17 teacher-approved applications evaluated in the fun and interesting category received the popular topic label. Therefore, almost all of the teacher-approved applications have popular topics. In this category, 13 applications received the label "lots of things to do", 10 applications received the label "tasks", eight applications received the label "surprises", five applications received the label "characters" and two applications received the label "humor". Of the 17 applications evaluated in the category of specially designed for children, all of them received the labels words and sounds, ease of use, art and animation. Among the 17 teacher-approved applications evaluated in the creativity and imagination category, nine applications received the critical thinking label, eight applications received the role-playing game label, eight applications received the intriguing label, seven applications received the creativity label, six applications received the

imagination label, five applications received the innovative label, and no app received the beautiful story label. Among the 12 teacher-approved applications evaluated in the positive messages category, 10 applications received the label "love of learning", which was the most common label given in this category. Two applications received the environment label, and only one app was given the labels of diversity, friendship, family, empathy and emotions. Healthy nutrition and physical health labels were not given to any of the applications.

Table 15.

Age Appropriateness and Different Category Labelings for Teacher-Approved Applications

Suitable Age	**Number of Applications (17 Applications)**
Up to 5 years old	8
6-8 years old	9
Education Category Tags	**Number of Applications (12 Applications)**
Art	5
Mathematics	6
Social Sciences	0
Language Arts	4
Music	1
Emotional Literacy	1
Science	1
Fun and Interesting Category Tags	**Number of Applications (17 Applications)**
Popular topic	16
So many things to do	13
Surprises	8
Humor	2
Characters	5
Tasks	10
Tags in the category Specially Designed for Children	**Number of Applications (17 Applications)**
Words and sounds	17
Ease of use	17
Art and animation	17
Creativity and Imagination Category Tags	**Number of Applications (17 Applications)**
Critical Thinking	9
Innovative	5
Imagination	6
Role Playing Game	8
Curiosity Arousing	8
Creativity	7
Good Story	0
Positive Messages Category Tags	**Number of Applications (12 Applications)**
Diversity	1
Physical Health	0
Environment	2
Love of Learning	10
Healthy Nutrition	0
Friendship	1
Family	1
Empathy	1
Emotions	1

4. Discussion and Conclusion

This study examined the status of mobile applications for children in supporting acquisitions in the preschool education program. In this regard, using the document analysis method, 24 applications were randomly selected from the educational applications for preschool children from the Google Play Store and examined based on the acquisitions in the preschool education program. The data were recorded in the application review form and the data obtained were analyzed in line with the purpose of the research.

Considering the question *"To what extent do mobile applications for children support the acquisitions in the preschool education program?"* and the findings from the study, the applications examined could support 28 acquisitions (44.44%) out of 63 acquisitions in the preschool education program, while 35 acquisitions (55.56%) could not support in any way. When analyzed according to developmental areas, 17 out of 21 acquisitions belonging to cognitive development, three out of 12 acquisitions belonging to language development, two out of 17 acquisitions belonging to social and emotional development, one out of 5 acquisitions belonging to motor development, and five out of eight acquisitions belonging to self-care skills could be supported. Twenty-one of the applications had in-app purchases. Although this does not affect the users much in some applications, in other applications, the free part is very limited, and the application forces the user to purchase paid items. In this case, more reasonable price arrangements can be made for educational applications for children or teachers and parents can be allowed to try paid items for free before purchasing them. In addition, users would not be misled by indicating in the app descriptions how many paid items are in the app. However, the menu section with in-app purchased items and settings is usually accessed with encryption that can be decrypted by an adult. This is a security method to prevent children from making accidental purchases. Advertisements were detected in nine applications. The absence of advertisements in most applications for children is a positive aspect. This is because the advertisements that usually appear in applications are not filtered through a certain filter. In user comments on nine applications with advertisements, there are negative comments such as the advertisements being too many and the application being difficult to use due to the frequency of advertisements. The research findings suggested that more acquisitions could be supported from the cognitive development area and self-care skills according to the number of acquisitions within themselves. The development areas in which the fewest acquisitions could

be supported were social and emotional development, motor development, and language development. Since cognitive development is the first thing that comes to mind in regard to developmental areas, or cognitive development is generally seen as equivalent to all development, cognitive development gains can be supported more. Social and emotional development and language development can be less supportable because they require the child to have an interlocutor and motor development can be considered less supportable because they require physical activity.

Considering the second question, *"Which acquisitions from the preschool education program supported by mobile applications for children are most supported by the applications?"* and the findings, the applications examined could support the cognitive development area mostly. All applications supported only the first acquisition belonging to the cognitive development area. Following this, 19 applications supported the fifth acquisition in the cognitive development area, 18 applications supported the sixth acquisition, 13 applications supported the eighth acquisition, and 11 applications supported the second, 12th and 15th acquisitions. In addition, the number of applications that can support the gains was 10 and below. When analyzed in terms of the number of applications that could support the gains, the least supportable development areas were the social and emotional development area, motor development area, and language development area. When examining the status of the hand-in-hand-to-preschool education books provided free of charge by the Ministry of National Education to children in preschool education in terms of supporting the learning acquisitions in the preschool education program, the learning acquisitions in the field of cognitive development were supported the most. However, the learning acquisitions in the field of social and emotional development were included only once. Similarly, acquisitions in the field of language development were also very few (Zelyurt & Osmanoğlu, 2022). In the study analyzing three different cartoons on TRT Children's Channel based on developmental areas, there were more acquisitions in the field of cognitive development. In the field of social and emotional development and language development, the same acquisitions were included in general and more acquisitions should be included in the field of motor development and self-care skills (Cengiz et al., 2020). Regarding the support status of TRT Children's Songs for the acquisitions in the preschool education program, it supported the acquisitions of all areas, particularly the acquisitions in the field of

language development. Therefore, by including different songs in mobile applications, unsupported developmental areas can be supported (Musuloğlu & Sezgin, 2024).

The third question *"Can mobile applications for children be a training tool for preschool teachers and can they be presented to families as a support training tool based on their ability to support the acquisitions in the preschool education program?"* has indicated that not every application can be a training tool based on the findings of the research. However, some applications can be used in line with a specific developmental area and a purpose for acquisitions. However, teachers should examine and select these applications not by labeling but by experiencing them themselves. Mobile applications are also used as educational tools worldwide (Can-Yaşar et al., 012; Kokkalia et al., 2016; Neumann & Neumann, 2017; Tarasuik et al., 2018). However, there are a limited number of applications that generally support acquisitions in the preschool education program. In fact, the number of applications that support acquisitions according to the grades of the world and universe subject area in science teaching showed that more applications supported fifth grade acquisitions, while no application was found to support eighth grade acquisitions (Özcan, 2020). In this regard, it is possible to use more applications as educational tools if application software developers produce applications considering educational programs and acquisitions. Based on the findings of the study, the applications generally support the cognitive development area. The reason for this may be that cognitive development usually comes to mind regarding the preschool period and mostly cognitive activities are preferred in terms of education. However, studies show that there may also be applications that support different developmental areas. It is possible to support expressive language skills by focusing on music and singing in the application (Altun, 2019), to support language and concept development by using augmented reality-enriched materials (Yıldırım, 2019), to support early literacy and phonological awareness skills (Arnold et al., 2021), and thus to support language development through mobile applications. It is also possible to increase receptive and expressive language development with scaffold-like applications. In addition, different educational models can guide application producers (Vatalaro et al., 2018). Although the social and emotional development area was determined as the least supportable area and there are few studies investigating the effect of applications on social communication skills (Griffith et al., 2019), several studies show that mobile applications can be used as tools in subjects, such as providing art education to children through applications (Kelekçi Olgun, 2017)

and raising their awareness about anger management (Nicolaidou et al., 2022). Other studies have shown that applications can support gains in language development and motor development rather than cognitive development (Herodotou & Mangafa, 2022) (Bebell & Pedulla, 2019). In addition, mobile applications can be a functional educational tool in different areas for children, such as the approach to fruits and vegetables and their effect on their liking (Vepsäläinen et al., 2022). They can also be a functional educational tool in science knowledge and executive function skills (Griffith et al., 2019). The applications can also support concepts when produced for the purpose (Demir, 2007). In addition, these applications can further be used as a tool to support education for children of families living in a low socioeconomic environment (Arnold et al., 2021; Vatalaro et al., 2018). Families with preschool children may also feel inadequate in terms of mobile applications and may need guidance on which applications can be educational and useful (Scott, 2022). There is an argument that in the future, teachers will become a guide on certain issues, such as accessing information and data in the right way, choosing the right source and eliminating inappropriate ones, rather than being a mere source of information. In this regard, teachers should be able to guide children and families correctly for mobile applications on mobile devices (Bardakçı, 2018).

It is possible to turn mobile devices into a useful tool for children within a certain period of time with applications selected considering issues such as children's curiosity about technology, their interest in technology, and having fun in the use of technology. There are many issues to be considered in the preparation and evaluation of mobile applications prepared for children. The scope of these considerations increases, particularly if it has an educational purpose. However, these issues are not taken into consideration by software developers. In general, when considering software developed for commercial purposes without any expert support, there is a trend of similarity among these software programs, and unfortunately, the benefit to children is not considered. In the evaluation of software, it is crucial to consider the suitability of the software for the development of the child, the suitability of the elements used for the child's age and developmental characteristics, whether the use, instructions and layout of the applications are intended for children, whether there is an age level specified for the application, the suitability of the characters in the game and the suitability for the child's health, whether there are negative elements, advertisements and subliminal messages, the suitability

for their culture, originality, and the suitability of the evaluation, stages, way of playing and duration of the game for the child (Kol, 2021).

This study was conducted to investigate whether mobile applications support acquisitions in the Turkish preschool education program. According to the results, the applications did not support the acquisitions at the expected level. Examination of the applications that did support the acquisitions within the framework of developmental areas showed that the majority of them focused on one developmental area. In the literature, there are studies investigating the effects of applications in diverse developmental areas, as well as studies on the use of mobile applications as a support education tool for children from families with low socioeconomic status. In this context, some applications can be used by teachers both as educational tools and shared with families in terms of supporting certain acquisitions. In the application software, producers can produce applications that are more functional and more original in terms of education and have different purposes considering the acquisitions in the preschool education program. Producers can create diverse applications that can nourish developmental areas not supported much. Future researchers can investigate into the effects of the applications on children's acquisition of certain acquisitions in practice.

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Review Article

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Artificial Intelligence and Innovative Applications in Special Education

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Abstract

Artificial intelligence can be defined as systems or machines that mimic human intelligence to perform tasks and can iteratively improve itself based on the data they gather. Artificial intelligence applications, which are among the innovative educational technologies, have been frequently used in the field of education as well as in other fields such as entertainment, medicine, cyber security, transportation, tourism, e-commerce, banking, and finance. Developments in artificial intelligence applications have brought different innovations in the field of special education as well as in the other areas of education. The current study aims to examine the current situation of artificial intelligence applications to meet the needs and desires of individuals with special needs and to provide with a broader perspective on this issue. Narrative review method is used to fulfill the purpose of this study since it neither requires predetermined research question nor specific search strategy. Through narrative review, it can be concluded that, artificial intelligence applications are successfully applied to meet the needs and desires of individuals with special needs. Artificial intelligence, which is personalized according to the needs of individuals, determines their deficiencies, and offers the advantage of personalized support for their development. In addition, thanks to artificial intelligence applications, individuals with special needs express their feelings more easily by interacting with their parents, teachers, psychologists, and others around them. These applications also provide individuals with the opportunity to discover their talents. It is also seen that artificial intelligence offers some important advantages such as saving time and cost, creating more efficient and effective learning environments.

Keywords: Artificial intelligence, Machine learning, Deep learning, Special education, Disability

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Özel Eğitimde Yapay Zekâ ve Yenilikçi Uygulamalar

Özet

Yapay zekâ, görevleri yerine getirmek için insan zekasını taklit eden ve topladıkları verilere göre kendini yinelemeli olarak geliştirebilen sistemler veya makineler olarak tanımlanabilir. Yenilikçi eğitim teknolojileri arasında yer alan yapay zekâ uygulamaları, eğlence, tıp, siber güvenlik, ulaşım, turizm, e-ticaret, bankacılık, finans gibi diğer alanlarda olduğu gibi eğitim alanında da sıklıkla kullanılmaktadır. Yapay zekâ uygulamalarındaki gelişmeler eğitimin diğer alanlarında olduğu gibi özel eğitim alanında da farklı yenilikleri beraberinde getirmiştir. Mevcut çalışma, özel gereksinimli bireylerin ihtiyaç ve isteklerini karşılamaya yönelik yapay zekâ uygulamalarının mevcut durumunu incelemeyi ve bu konuda daha geniş bir bakış açısı sunmayı amaçlamaktadır. Önceden belirlenmiş bir araştırma sorusu veya belirli bir araştırma stratejisi gerektirmediği için bu çalışmanın amacını gerçekleştirmek için anlatı incelemesi yöntemi kullanılmıştır. Anlatı incelemesi sonucunda yapay zekâ uygulamalarının özel gereksinimli bireylerin ihtiyaç ve isteklerini karşılamada başarılı bir şekilde uygulandığı sonucuna varılabilir. Bireylerin ihtiyaçlarına göre kişiselleştirilen yapay zekâ, onların eksikliklerini belirlemekte ve gelişimleri için bireye özel destek avantajı sunmaktadır. Ayrıca yapay zekâ uygulamaları sayesinde özel gereksinimli bireyler ebeveynleri, öğretmenleri, psikologları ve çevrelerindeki diğer insanlarla etkileşim kurarak kendi duygularını daha rahat ifade etmektedirler. Bu uygulamalar, bireylere sahip oldukları yetenekleri keşfetme fırsatı da sunmaktadır. Yapay zekanın zamandan ve maliyetten tasarruf etmek, daha verimli ve etkili öğrenme ortamları oluşturmak gibi bazı önemli avantajlar sunduğu da görülmektedir.

Anahtar Kelimeler: Yapay zekâ, Makine öğrenme, Derin öğrenme, Özel eğitim, Yetersizlik

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1. Introduction

With the rapid progress of technology and science, people's interest in technology products is increasing day by day, regardless of what age they are and what environment they live in. The use of technological products that affect every aspect of daily life is also frequently encountered in the field of education. Developments in technology have brought different innovations in the field of special education as well as in other areas of education. Beside the proliferation of information sources in technology and the increase in the variety of technological products, technology secures its position in the field of special education day by day through its various effects, such as easy accessibility, rapid use, and appealing to more than one sense.

Rapid technological development has caused significant changes in the lives of individuals with special needs. The use of technology in special education offers individuals the opportunity to learn without the restriction of time and place. In technology-supported special education environments, instruction can be carried out according to students' own interests and needs, taking individual differences and learning styles into account. In such environments, individuals can learn by themselves according to their own learning speed and develop the ability to access information without the help of another individual. Through the effective use of technology, individuals with special needs can express themselves more easily in any subject or field in which they want to express themselves.

Artificial intelligence (AI) has played an undeniable role in most of the technological developments of recent years. AI-based computer applications, robots, and other technological devices provide users with great convenience in all areas of human life. In recent decades, AI applications have also begun to find a place in the field of special education. It is anticipated that AI applications will be useful for the diagnosis and evaluation of individuals with special needs, the design of instructions by taking individual differences and learning speeds into account, and the development of independent living skills. Recent developments in AI applications in special education can enable the development of collaborative, interactive environments for individuals with special needs and facilitate their lives and those of their caregivers. Applying AI, it is possible for individuals with special needs to improve their quality of life in school, home, and work environments.

Looking at the AI studies in the special education literature, one may realize there are several studies conducted in the field. Yet, a closer look suggests that few of them review studies (Barua et al., 2022; Chassignol et al., 2018; Drigas & Ioannidou, 2013; Drigas & Ioannidou, 2012). Barua et al., (2022) summarize the diversity and effectiveness of artificial intelligence-assisted tools developed using machine learning models to address learning difficulties in students with neurodevelopmental disorders. Chassignal et al., (2018) conducted research to determine the impact of AI on education and to offer a broad perspective on this issue. Drigas and Ioannidou (2013) present some studies between 2001 and 2010 using AI methods for accurate diagnosis and intervention in individuals with special needs. Drigas and Ioannidou (2012) present some studies between 2001 and 2010 that were used for diagnosis and intervention in different disability groups. When these studies in the literature are examined, it is seen that there is no current and comprehensive study on artificial intelligence applications in special education. The purpose of this article is to examine the current situation of artificial intelligence applications to meet the needs and desires of individuals with special needs and to provide a broader perspective on this issue. This study is expected to contribute to the literature and increase awareness of the developments in artificial intelligence applications in the field of special education. In addition, this study explicates the connection between artificial intelligence and special education. It is also expected that the study will guide the use of artificial intelligence in special education and contribute to the design of artificial intelligence applications to be developed for individuals with special needs. In the following sections, explanations about artificial intelligence and its sub-branches are given.

1.1. Artificial Intelligence

Artificial intelligence is a complex concept in its use, configuration, and development processes. It is defined in different ways by many researchers. John McCarthy, one of the pioneers of artificial intelligence, stated in 1955 that the purpose of artificial intelligence was to develop machines that acted as if they were intelligent (Ertel, 2017). Sağıroğlu et al. (2003), on the other hand, define the human brain as thinking, interpreting, and learning situations by imitating them with the programming method and using them for problem solving. According to another definition in the literature, artificial intelligence is all activity dedicated to making machines intelligent (Wang et al., 2015). In this definition, artificial intelligence is explained as the attribute that enables an entity to work appropriately and predictably in its environment. Şen

(2018) expressed artificial intelligence as the conversion of human intelligence into computer software by making simplifications, emphasizing that artificial intelligence was inspired by the functions of the human brain to facilitate social and economic life. Although the definitions of artificial intelligence are made in different ways, the common point is that computers with artificial intelligence software use existing data to behave in a way that can be considered intelligent.

1.2. Sub-Branches of Artificial Intelligence

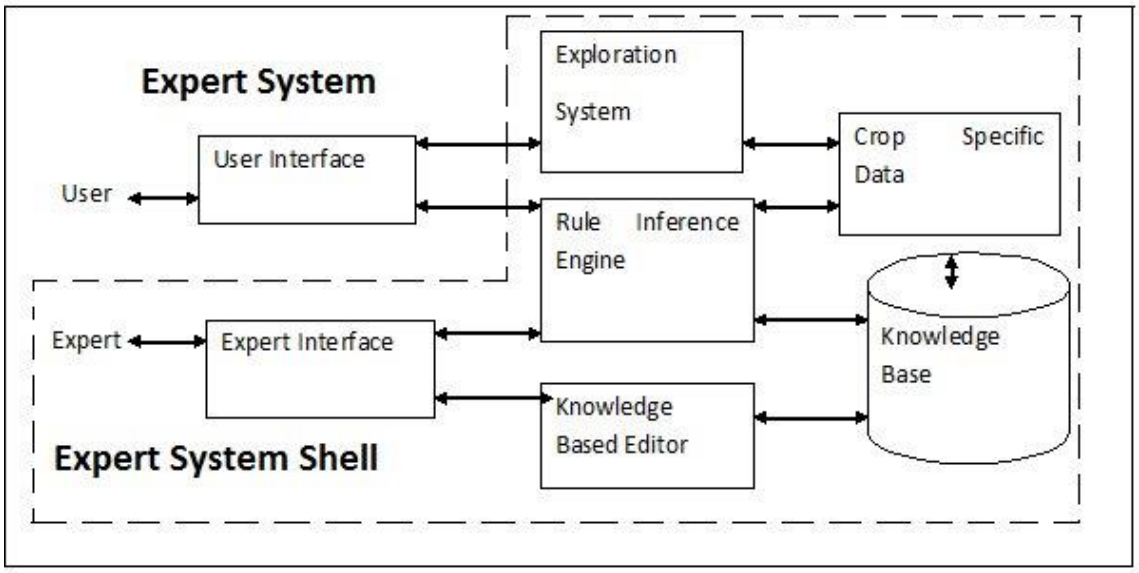
The definition of artificial intelligence covers a very wide area. The necessity of conducting field-specific studies has led to the emergence of sub-fields of artificial intelligence. These sub-fields include expert systems, intelligent agents, machine learning, artificial neural networks, deep learning, genetic algorithms, fuzzy logic, intelligent teaching systems, and natural language processing.

Expert Systems

An expert system is a computer program designed to imitate the judgment and behavior of someone with vast knowledge and experience in a particular field (Gupta & Nagpal, 2020). Expert systems indeed consist of a knowledge base that contains cumulative experiences, and rules that guide how to use that knowledge base in each specific situation. Gupta and Nagpal (2020) described the qualities of a good expert system as: meeting a specific need, being user-friendly, allowing users to increase their own expertise by using the system, explaining the reasoning process, asking questions to the user to obtain additional information, providing high-quality output, producing decisions just in time, and using heuristics. Expert systems are generally comprised of the following elements: the interface that provides communication between the user and the system; the knowledge base that contains the information obtained from the field experts; the database where the data of the problem to be solved is kept, the inference engine that produces the reasoning of the rules; and the rules used in inference. It consists of an explanation facility, where it is explained to the user, and a knowledge base editor that enables experts and information specialists to exchange data with the data system. The model of the components in the expert system architecture is shown in Figure 1.

Figure 1.

Expert systems architecture (Source: Islam, 2013; ShellAg: Expert System Shell for Agricultural Crops.).



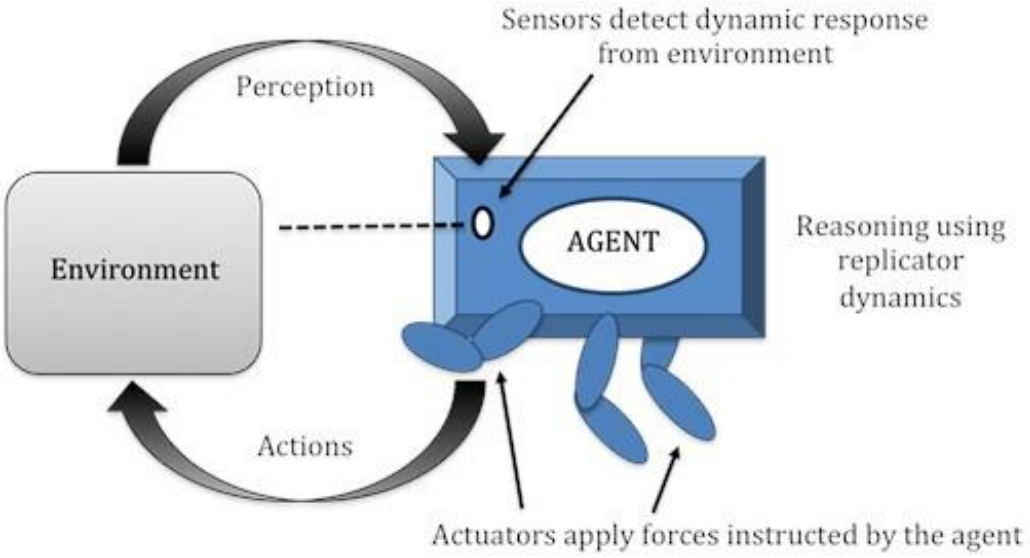
Intelligent Agents

Intelligent agents may be defined as software that carries out operations for users or programs after detecting the environment (Mbaabu, 2020). They are also known as systems that can make decisions by themselves based on the current situation by using a variety of artificial intelligence techniques. An agent generally refers to a system that can process data to produce outputs from inputs (Ertel, 2017). An agent can be viewed as anything that perceives its environment through sensors and acts in that environment through actuators (Russell & Norvig, 2020). Relying on this definition, literature suggests three different types of agents: human, robot, and software agents. People have organs and limbs that enable them to perceive the environment (e.g., eye, ear, etc.) and move in the environment (e.g., arm, foot, etc.). These features are sufficient to consider them agents. The reason why robots are considered agents is that they have sensors such as cameras and infrared range finders that they use to sense the environment, and motors that provide them with movement. Software agents, on the other hand, use input from humans and other file contents that are received through input units to detect the environment. In addition, they take actions such as sharing, displaying, and printing the outputs they produce. That is why software may also be considered intelligent agent (Russell & Norvig, 2020). An intelligent agent basically consists of an architecture with sensors and actuators (a robotic car, a computer, etc.) and an agent program. Intelligent agents take various perceptions or pieces of information from the environment, process them using

machine learning algorithms, and then act as programmed or trained. The structure of an intelligent agent is demonstrated in Figure 2.

Figure 2.

Structure of intelligent agents (Soto & Adeli, 2017).



Machine Learning

Machine learning is a collection of algorithms that can learn from recorded data and make predictions based on it, optimize a certain utility function under uncertainty, extract hidden structures from data, and classify data (Amazon, 2021). The idea of transferring the necessary skills to the computer through examples that the machine can learn, instead of giving the instructions to the computer directly, allowed the machine to learn (Kubat, 2017). Machine learning is divided into three sub-branches: supervised machine learning, unsupervised machine learning, and reinforcement learning. They can develop a model with supervised machine learning, which includes popular algorithms such as decision trees, support vector machines, linear regression, logistic regression, and nearest neighbor. To create a solution (model) of a problem with supervised machine learning algorithms, a training dataset is required. The training dataset must include both output and input data related to the problem that is expected to be solved. Thanks to the training data set, machines can learn the relationship between input and output data. Based on the input-output relations it learned, it can perform operations like classification and regression. The goal of this type of machine learning algorithm is to predict the output data from known input data using the learned input-output data relationship. On the contrary, using datasets that do not contain specified input-output

relationships, unsupervised machine learning algorithms such as clustering, principal component analysis, and association rules aim to discover patterns, identify relationships among data, and group data within datasets. Semi-supervised learning perceives the situation or environment it is in, matches the situation with alternative actions, and focuses on systems that can decide which action to take for long-term benefit (Kaur et al., 2021). Machine learning has a wide range of applications. The most preferred ones are applications such as face recognition, understanding spoken language, optical character recognition, mail filtering, medical uses, prognosis and diagnosis, object recognition, etc. (Rende et al., 2016).

Artificial Neural Networks

Artificial neural networks are parallel and distributed information processing structures that are connected to each other through weighted connections and comprised of processing elements that each have their own memory; in other words, they are computer programs that imitate biological neural networks (Elmas, 2003). Artificial neural networks can use biological brain abilities such as learning and making fast and situational decisions to solve nonlinear problems. Just as external stimuli are needed for learning to occur in biological organisms, artificial neural networks also require external stimuli. The external stimulus in artificial neural networks is provided with training data containing examples of input-output pairs of the function to be learned (Aggarwal, 2018). Many input-output pairs provide information about the problem to be solved. Artificial neural networks can make solution-oriented generalizations using the provided information. Once they are fed with enough data, artificial neural networks produce outputs from single inputs based on previously learned input-output pairs in the problems. The ability of artificial neural networks to learn from input-output pairs and generalize from what they have learned has allowed them to be widely used in many fields such as image and sound recognition, fault analysis, prediction and estimation, control and system identification, medicine, communication, and traffic (Pirim, 2006). Artificial neural networks basically consist of processing units called nodes located in the input layer, the output layer, and the hidden layers between those two. The nodes in each layer are connected to the nodes in the previous and following layers. Connections between nodes have certain weights. The data progresses from the input layer to the output layer. The data is multiplied by the weighting coefficient between the relevant nodes. At each node, the weighted values obtained from the nodes in the previous layer and bias are summed together and used as input for an

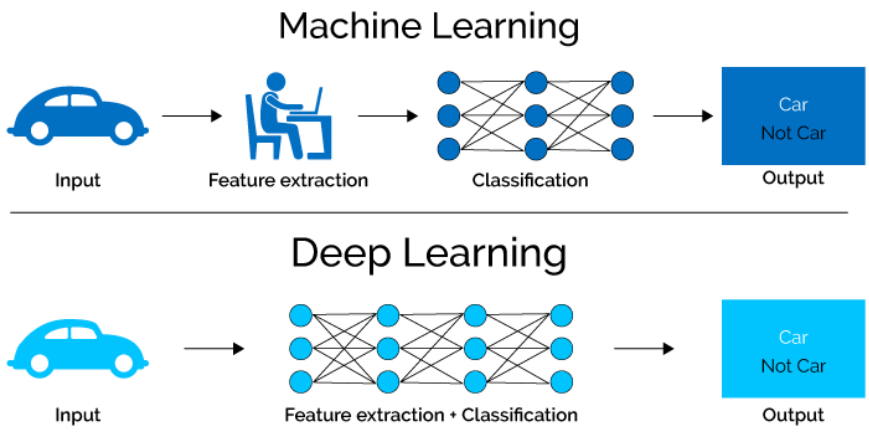
activation function. The output of the function is then passed as input to the processing unit in the following layer. The function result of the output layer produces a solution to the problem (Shrestha & Mahmood, 2019). Most basic machine learning models, such as linear regression, classification, support vector machine, and logistic regression are simulated with neural networks with one or two layers. While artificial neural networks comprised of two- or three-layers are considered simple artificial neural networks, artificial neural networks containing more than three layers can be considered deep learning (Skansi, 2018).

Deep Learning

Deep learning is a special approach that tries to learn high-level abstractions using hierarchical architectures produced by increasing the number of hidden layers in simple artificial neural networks (Guo et al., 2016). Deep learning aims to expand the scope of supervised, unsupervised, and reinforcement learning to solve other problems in the field of artificial intelligence that simple machine learning algorithms are unable to solve, such as reasoning and planning (Skansi, 2018). Deep learning is used for many different processes, such as signal processing, image processing, language processing, and voice recognition. Figure 3 depicts the comparison between machine learning and deep learning.

Figure 3.

Comparison between machine learning and neural network (Source: Mao et al., 2020).



Genetic Algorithms

The use of metaheuristic algorithms, such as genetic algorithms, that allow one to find solutions to real-life problems in many fields, including education, is becoming increasingly common

(Kumar et al., 2014). Genetic algorithms, one of the best-known AI subfields, are a family of computational models inspired by biological evolution. These computational models optimize the search tool for real-life problems by imitating the natural selection principle to find one of the best possible solutions (Lambora et al., 2019). Since genetic algorithms mimic the theory of survival of the fittest in nature, they yield solutions for successive generations (Katoch et al., 2021; Lambora et al., 2019). To find one of the best solutions, genetic algorithms go through the following main phases (Mathew, 2012; Mirjalili et al., 2020):

1. Initialization: To solve a problem through a genetic algorithm, the population of chromosomes must be defined first. Each chromosome can be depicted as an alternative solution point in the solution space.
2. Fitness Function: This is the phase in which the suitability of each solution is calculated and evaluated.
3. Selection: According to fitness values, the chromosomes are selected as many times as it takes to obtain enough progenitor chromosomes that will produce offspring solutions to replace the solution set.
4. Crossover: In this phase, fixed sections of progenitor chromosomes are swapped to produce offspring solutions to the problem.
5. Mutation: It is the phase where random tweaks occur within the chromosomes to prevent the algorithm from getting stuck at local optima.

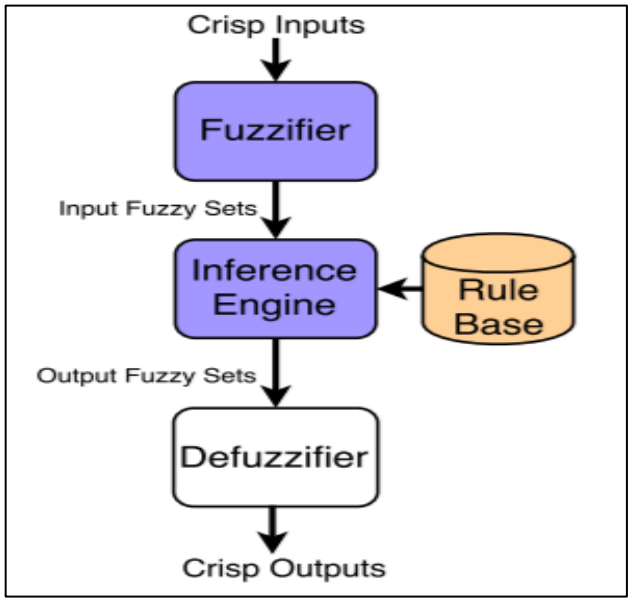
Fuzzy Logic

In classical logic, every entity belongs to a certain set. The elements of the set are determined. One entity is either a member of a set or it is not. In fuzzy logic, there is the concept of partial membership. In fuzzy logic, an entity can be a partial member of more than one set (Eğrisöğüt et al., 2007). Here we come across the concept of fuzzy sets. In fuzzy sets, the membership degrees of the set elements can take values ranging from zero to one (Zadeh, 1965). While determining the degree of membership, a generalized characteristic function known as the membership function is used (Eğrisöğüt et al., 2007). In classical logic, there are sharp limits to the set. The existence of partial membership differentiates fuzzy sets from classical sets. Fuzzy logic is a logical system that can explain the properties of any entity by looking at which set belongs to and to what extent; thus, it produces results for unclear situations (Kambalimath & Deka, 2020; Özdemir & Kalınkara, 2020). From a fuzzy logic point of view, there are degrees of

right or wrong, so it is possible to get more accurate results when fuzzy logic algorithms are used instead of classical logic in cases where right and wrong are intertwined. The basic workflow implemented in fuzzy logic systems is shown in Figure 4.

Figure 4.

Fuzzy logic workflow (Source: Bhattacharjee et al., 2018).



In order to apply the fuzzy logic technique, according to Bai, Zhuang, and Wang (2006), the following steps should be carried out:

1. Fuzzification: transform classical data or clear data into fuzzy set data or membership functions.
2. Fuzzy inference process: membership functions are combined with control rules to get fuzzy output.
3. Defuzzification: using different methods, each associated output is calculated and created into a chart like a lookup table. During an application, the appropriate output is reached from the chart according to the available input.

Natural Language Processing

Natural language processing is defined by Liddy (2001) as a set of computational techniques used to analyze naturally occurring texts at one or more levels of linguistic analysis in order to achieve human-like language processing. The purpose of natural language processing is to analyze the rules of natural languages to be understood or reproduced. Working in the

background of many services, from chatbots to virtual assistants, Natural language processing enables machines to find the complex meaning in our sentences (Ambroz, 2019).

Natural language processing enables machines to perform many functions, such as translating written documents, understanding and responding to verbal/textual commands, synthesizing speech, producing speech, and summarizing texts.

2. Method

This study was conducted using the narrative analysis method. Narrative inquiry is a qualitative research method that involves a comprehensive data collection and analysis process. This method does not require the identification of a definite research question or hypothesis in advance. Therefore, it offers a more flexible approach and allows researchers the freedom to conduct a comprehensive examination of various topics or problems. Furthermore, narrative inquiry can involve a wide variety of sources and data. This enables researchers to address a variety of stories, views and perspectives from different sources. In cases where there is insufficient knowledge about a particular research topic, narrative inquiry can be used to explore existing literature and identify potential research topics. As a result, the narrative inquiry method is considered a useful research method when it is difficult or inappropriate to formulate a specific research question or search strategy. This method can serve a variety of research purposes and offer researchers greater flexibility and freedom of exploration (Ferrari, 2015; Green et al., 2006).

In this study, the narrative inquiry method was adopted to gain a comprehensive understanding in the fields of special education and artificial intelligence. The research was conducted following the steps suggested by Demiris et al. (2019). Firstly, a search was conducted in reputable databases such as Web of Science, Scopus and Springer Ebooks using general subject keywords such as special education, artificial intelligence and virtual assistant. Then, more specific keywords were defined by reviewing these documents and searches were conducted in other sources with these keywords. The documents were meticulously analysed and carefully selected to obtain the intended information, which was then synthesised and summarised to report the findings. Following these steps increased the accuracy, reliability and the ability of the research to provide a detailed review. The research has the potential to provide greater understanding of important issues and topics at the intersection of the fields of special

education and artificial intelligence. A careful review of the documents yielded the intended information, which was then summarized, and the findings reported. Following these steps has increased the accuracy, reliability, and capacity of the research to provide a detailed review. The research has the potential to provide a deeper understanding of important issues at the intersection of special education and artificial intelligence.

3. Result

Indeed, almost all the artificial intelligence technologies mentioned above have been developed for purposes other than special education. Nevertheless, their use in the special education field has become increasingly widespread over time. The following sections are about the use of artificial intelligence for the purpose of facilitating the lives of individuals with special needs.

Artificial Intelligence Applications in Individuals with Visual Impairments

For centuries, people have resorted to technology to facilitate the lives of individuals with visual impairments. One of the focal points of recent technological innovations is to help individuals with visual impairments. To allow individuals with visual impairments to live independently, many wearable technologies and mobile applications based on artificial intelligence technology have been developed and offered to users. Using these products, users with visual impairments can recognize and communicate with people around them; they can identify money and objects, which allows them to shop independently, beside printed and digital texts, they can read handwriting. Thus, AI-supported technology enables them to interact with the world and even travel on their own in autonomous vehicles.

The Aipoly application is one of those innovative products that improves the lives of visually impaired individuals. Aipoly, which was launched in 2015, started to attract people's attention after winning the Consumer Technology Association's Innovation Award in 2017 (Rego, 2017). Relying on AI technology, the Aipoly application helps people with visual impairments recognize and interact with people as well as objects around them. The application captures the image of the object to be defined and transforms it into words or sentences in a short time using artificial intelligence algorithms. This may seem like a simple task, but it is an AI driven system that uses the same machine learning techniques as robots. Various artificial neural network models are running in the background of the application to provide immediate responses to users (Mao et al., 2020). People can easily recognize the appearance of new things, remember

their names, and categorize things that look similar using their senses such as sight, hearing, and touch. Aipoly is used to identify people, food, household items, store packaging, plants, animals, colors, text, etc. (Najafzade, 2020). The biggest handicap of this application is that users have to point the camera at the object they wish to identify (Mulfari et al., 2017). Santoki and Patvardhan (2019) conducted mixed research with 40 visually impaired people to evaluate the effectiveness of Aipoly vision. They found that 80 percent of the participants are extremely happy with Aipoly vision. They stated that Aipoly's vision is "completely helpful, whereas the rest have faced certain inconveniences" (p.271). They also reported that "a set of people are not fully convinced of the AI-based apps functioning. These were typically based on incorrect object identification, difficulty in understanding the accent and a lack of facility for regional language conversion" (p. 271).

OrCam company, which defines its mission as benefiting from the power of machine vision by incorporating innovative technologies into wearable technologies to make the lives of those with visual impairment and those having reading difficulties, developed the MyEye device in 2015 and the second generation MyEye 2.0 in 2017 (OrCam, 2021). Using advanced artificial intelligence technology, MyEye helps visually impaired individuals read text, recognize faces, distinguish products and brands, and identify currency. It aims to increase the quality of life of individuals with visual impairments and those having reading difficulties through advanced machine vision technology. MyEye is a small wearable device that can read digital text as well as printed text on physical media such as newspapers, books, food labels, street signs, and restaurant menus. The first generation Orcam MyEye has an 8-megapixel camera, and the text-to-speech feature is initiated with the "trigger" button on the device (Granquist et al., 2021). Its face recognition system can recognize faces previously saved in the device's memory. Once a user enters the MyEye view, the user's name is announced. MyEye is comprised of two parts, a head unit and a processor unit. A head unit has a camera, which can be attached to any eyeglass, and a speaker, whereas a processing unit has a charger port and buttons (e.g., power, trigger, and volume) to operate the device (OrCam, 2021). The user can read the text by either clicking MyEye's "trigger button" or simply pointing their finger at the text. This is an assistive technology tool that can be activated by hand gestures. With MyEye, people with reading difficulties can read books or their own emails anytime, anywhere. Face recognition technology makes visually impaired individuals more comfortable and active in their social environments.

MyEye also supports multiple languages, such as English, German, Italian, Spanish, Hebrew, and French. Wearables like the OrCam MyEye can help people with low vision read books (text and pictures), recognize faces, and even distinguish between products and brands. It enables individuals with visual impairments to meet other people and socialize in society. It gives them greater mobility by enabling them to recognize traffic signals and street signs.

Seeing AI, a device similar to OrCam MyEye, allows visually impaired individuals to recognize faces and money, read handwriting, to scan barcodes, and distinguish products. Granquist et al., (2021) conducted a study to compare the performances of these two devices, which both rely on artificial intelligence technology. Their study reported that,

> "Both aids achieved greater than 95% accuracy in text recognition for flat, plain word documents and ranged from 13 to 57% accuracy for formatted text on curved surfaces. Both aids could read print sizes as small as 0.8M (20/40 Snellen equivalent, 40 cm viewing distance). Individuals successfully completed 71% and 55% (p = .114) of tasks while using Orcam MyEye 1 and Seeing AI, respectively. There was no significant difference in time to completion of tasks (p = .775). Individuals believed both aids would be helpful for daily activities" (p. 277).

AI technology is also used to enable individuals who cannot drive a motor vehicle due to their mental or physical disabilities to travel independently and safely. There is a self-driving vehicle project relying on artificial intelligence technology that is still under development. The first fully functional prototype that is 100% autonomous without a steering wheel, brake pedal, or accelerator pedal and collects information through many cameras and sensors on it was produced by Google. The first fully autonomous vehicle used on public roads was tested in the state of Texas, USA, with its only visually impaired passenger named Steve Mahan (Goggin, 2019). The autonomous vehicle developed by Google is just one of many self-driving cars that use artificial intelligence technology to assist individuals with special needs.

Artificial Intelligence Applications in Individuals with Hearing Impairments

AI technology also changes the lives of individuals with hearing impairments. AI-based smart hearing devices such as Widex's Evoke provide a hearing aid wirelessly. While the hearing device is connected to the EVOKE application running on the smartphone, EVOKE can receive surrounding sounds and classify them as "background noise" or "significant noise" (WS Audiology, 2022). This app allows individuals with hearing impairments to focus on the sound they want to hear. The app (e.g., EVOKE) that comes with the hearing aid allows individuals with hearing impairments to set their preferences for the sound they want to hear.

The recently developed Widex EVOKE hearing aid is designed to meet the wearer's real-life listening intent through a combination of automation and personalization. In EVOKE, this customization is provided by SoundSense Learn (SSL), a real-time machine learning algorithm that quickly and intuitively adjusts hearing aid parameters to provide the user with the best listening experience (Balling et al., 2019). SSL is a feature in Widex MOMENT™ and Widex EVOKE™ devices that optimizes sounds using artificial intelligence according to the environment the user is in (Balling et al., 2021; Nielsen, Nielsen, & Larsen, 2014). Balling et al. (2019) conducted a large-scale multinational survey to investigate users' experiences of Widex EVOKE and evaluate the effectiveness of this artificial intelligence-based hearing aid. The study revealed that 88% of the participants stated that the performance of the artificial intelligence-based Widex EVOKE hearing aid in noisy environments is better than the hearing aids they use. Their study proved particularly the advantages of the SoundSense Learn feature, which personalizes sound in the moment via a machine learning algorithm. In addition, it was emphasized in the study of McCormack and Fortnum (2013) that the EVOKE device provides significant advantages in noisy situations, which are known to be very difficult for hearing aid users.

With the help of smart hearing aids, adults and children with hearing impairments can live a more comfortable life with their parents, employees at work, students in the classroom, and others. For students with hearing impairments, this means that they can fully participate in classroom activities and engage in social interaction with other students.

Artificial Intelligence Applications in Individuals with Language and Speech Disorders

Voula et al. (2003) proposed a fuzzy cognitive map or soft computation model to determine the differential diagnosis of individuals with speech and language disorders. Fuzzy cognitive maps are a flexible computational tool comprised of the synergy of fuzzy logic and neural network methodologies, utilizing the experience of expert scientists (Dickerson & Kosko, 1997). Speech and language disorder is difficult to define because it has signs and symptoms similar to those of other diseases. With the help of this computational tool, experts will be able to distinguish between speech and language disorders and other types of disabilities such as autism and dyslexia.

Schipor et al. (2010) designed a computer-based speech therapy system using a fuzzy expert system to assist students with hearing and speech impairments. This clinical tool can recommend optimal therapeutic actions (number, length, and content of training sessions) for each individual and create an optimal exercise set based on available data (test scores and social, cognitive, and affective parameters). In the experiment conducted by Schipor et al. (2010), there was no statistically significant difference in therapy success between the experiment group using the fuzzy expert system and the control group. It, however, revealed some other advantages of using the expert system, such as interpretability, predictability, and a longer treatment duration.

In 2017, a Tel Aviv-based startup developed a hands-free voice recognition application called Voiceitt which translates elusive speech into clear words using artificial intelligence technology for real-time communication (Sherbin, 2018). Unlike language-dependent regular speech recognition systems, Voiceitt is a speaker-dependent system because it uses personalized deep learning algorithms such as pattern classification (Morero et al., 2020). The technology is designed to be integrated into smart speakers, smart homes, and other assistive and advanced communication devices. After opening the Voiceitt app, the user is prompted to write a short helpful sentence and then read it aloud, such as "turn off the light" or "I'm thirsty". The app records the pronunciation of the speaker (i.e., speech-impaired person) and starts learning. After a short training period, the Voiceitt app converts the user's expression to a standardized voice, and the output is generated as text or voicemail. Voice-controlled devices and apps can easily understand newly created text or voice messages. In short, Voiceitt helps people communicate face-to-face with others by making sense of the non-standard speech of people with congenital or acquired language and speech disorders, including cerebral palsy, autism, cerebrovascular accidents, Parkinson's disease, brain tumors, and traumatic brain injuries (Murero et al., 2020).

Artificial Intelligence Applications in Individuals with Learning Disabilities

Another good example of the use of artificial intelligence in special education is a model called PLEDOR (Perceptron-based Learning Disability Detector). PLEDOR is an artificial neural network model that can detect reading, writing, and math learning difficulties through curriculum-based tests conducted by special educators (Jain et al., 2009). This computational

diagnostic model consists of a single 11-unit input layer and an output unit corresponding to the different parts of the routine test. The study with 240 participants in India showed that PLEDOR provides easy use and yields comparable results in accordance with acknowledged test measures (Jain et al., 2009).

Pavlopoulos et al., (2008) used an artificial neural network to develop an assessment system for students and then optimized it using genetic programming. This system is designed to evaluate users' responses to questions in an e-learning environment and assess the following learning domains: (1) reading, (2) writing, (3) spelling/vocabulary, (4) grammar/sentence and letter recognition, and (5) alphabetical order. The use of genetically programmed neural networks (GPNN) as an e-learning assessment system is effective for students having difficulties in the areas listed above. It may also be beneficial for people with sensory or physical disabilities. This assessment system successfully evaluates the user's response. Additionally, this assessment system may lead to other innovations in e-learning.

Artificial Intelligence Applications in Individuals with Autism Spectrum Disorder

Children with autism spectrum disorder may experience avoidance of eye contact and a certain lack of facial expression. The following behavioral tendencies are observed in these children: inability to express one's feelings and emotions|; inability to recognize the feelings of others; passivity in interaction; interacting in an aggressive, destructive, or inappropriate way. In addition to not being able to initiate or maintain a dialogue spontaneously, they may also experience other problems such as not speaking, speaking late, or losing the ability to say previously acquired words or phrases. Despite these problems experienced by children with autism spectrum disorder, studies in the literature provide some evidence that artificial intelligence technologies are helpful in overcoming these difficulties (Şen, 2021).

TecO, a 50-cm-tall artificial intelligence robot resembling a cartoon bear, records the signals from the child with autism spectrum disorder and translates those signals into information that can be evaluated by a psychologist or neurologist (Sadauskaite, 2017). Because the robot TecO is emotionless, static, and predictable, it is aimed at connecting with children with autism spectrum disorder more easily. TecO observes the child, and as soon as the child begins to lose interest, it moves and makes sounds to attract the child's attention again. It also has a camera that can record the number of eye contact points and quantitatively measure the child's

progress (Sadauskaite, 2017). Two more robots (e.g., Bandit and Darwin-OP2) similar to TecO are under development. They can record every word of a child with autism spectrum disorder and monitor their development (Sadauskaite, 2017).

Kaspar is a humanoid robot designed as a social friend to improve the lives of children with autism spectrum disorder or any other communication difficulties (Wood et al., 2019). This robot helps teachers and parents support children with autism spectrum disorder to overcome the difficulties they face in socializing and communicating with others. QTrobot is another humanoid social robot designed to help teach social skills to children with autism spectrum disorder (Costa et al., 2018). Robots can help to speak directly and facilitate instructions without having to explain social cues which helps children with autism spectrum disorder focus on the skills being taught rather than explaining the social cues. In the future, these humanoid robots are expected to play the roles of playmate and therapist at the same time. They are also expected to help children with autism spectrum disorders participate more in social activities. In addition, robotic machines allow the possibility of continuous data collection to monitor children's development and the repetition of relevant social interactions to ensure the retention of learned social skills.

Wearable devices can also be used to predict diseases, provide advice on how to stay healthy, and even help people overcome their growing social challenges. In a project at Stanford University, Google Glass equipped with artificial intelligence technology to create a device called Autism Glass, which allows children with autism spectrum disorder to understand the facial expressions of others (Haber et al., 2020). Autism Glass allows a person to recognize others' emotions and act accordingly. This tool is designed to reduce the level of anxiety that people with autism spectrum disorder experience during social interaction. Once an individual wears Autism Glass, artificial intelligence software can read the facial expressions of the person in front of him. Each pair of these smart glasses has an overhead display that can reflect emotions appropriate to the human face, and users need to read emotions so they can identify how others are feeling (Singh et al., 2022). Catalin Voss et al. (2019) examined the effect of a wearable AI intervention designed for home use on improving socialization to strengthen facial interaction and emotion recognition in children with autism spectrum disorder. In their study of 71 children with autism spectrum disorders, children treated with the wearable intervention

at home showed significant improvement in socialization compared to children who received standard-care behavior therapy alone.

4. Discussion and Conclusion

Artificial intelligence and its sub-branches are included in this research, which was carried out in order to examine the current situation of artificial intelligence applications to meet the needs and wishes of individuals with special needs and to offer a broad perspective on this issue. In addition, artificial intelligence applications used in different disability groups such as visual impairment, hearing impairment, language and speech disorder, learning disability and autism spectrum disorder and important research findings in these areas are mentioned. Considering the results of the research, artificial intelligence applications are successfully applied to meet the needs and wishes of individuals with special needs. Artificial intelligence, which is personalized according to the needs of individuals, determines their deficiencies and offers the advantage of personalized support for their development. In addition, thanks to artificial intelligence applications, individuals with special needs express their feelings more easily by interacting with their parents, teachers, psychologists and other people around them. These applications also offer individuals the opportunity to discover their talents. It is also seen that artificial intelligence offers some important advantages such as saving time and cost, creating more efficient and effective learning environments. However, there is a need for more research on artificial intelligence applications due to the multiplicity of difficulties encountered in special education and the different needs and wishes of each individual. This research was limited to artificial intelligence applications in individuals with visual impairment, hearing impairment, language and speech disorders, learning disabilities and autism spectrum disorders. Future studies can contribute to the literature by examining artificial intelligence applications used in other disability groups. Artificial intelligence applications provide promising benefits in special education, and if these applications are developed more and more each day, they can help solve the problems of individuals with special needs, their parents, educators, and researchers.

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Science Teachers' Perspectives on Vaccination and Its Integration into the Science Curriculum

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Abstract

Socioscientific issues (SSI) are complex dilemmas that lack clear-cut answers. The purpose of this current study was to investigate in-service science teachers' perspectives on vaccination, considered as an SSI, and assess their views regarding its significance in science education and potential integration into the curriculum. Forty-nine in-service science teachers participated in this study, using convenient sampling, and collected their responses to six open-ended questions administered online. Teachers were asked whether they discuss everyday topics in the classroom, and most teachers confirmed that they integrate daily-life subjects into their lessons. Similarly, in response to questions about including science-related topics not covered in the curriculum, the majority expressed their willingness to engage in these discussions, especially regarding vaccination. Regarding their ability to provide information about vaccination, a significant portion of science teachers reported feeling confident in their capacity to do so. Additionally, when asked about the importance of students' knowledge about vaccination and its integration into the curriculum, 39 teachers advocated for its inclusion, seven opposed it, and two acknowledged its significance but not integration into the curriculum. Notably, when questioned about the difficulty of explaining vaccination-related topics, 32 teachers indicated they would not encounter challenges. This research underscores the pivotal role of science teachers in fostering informed discussions about vaccination and highlights the potential benefits of integrating this crucial subject into science education. The research results revealed that science teachers gave substantial importance to events/situations related to science that are not included in the curriculum. Therefore, it is important to include SSI, such as vaccination, in the curriculum, provided that the necessary arrangements are made.

Keywords: Vaccination, Science Education, Science Teachers, Socioscientific Issues

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Fen Bilimleri Öğretmenlerinin Aşı ve Aşı Konusunun Fen Bilimleri Öğretim Programına Dahil Edilmesine İlişkin Bakış Açıları

Özet

Sosyobilimsel konular net bir cevabı olmayan, yoruma dayalı ikilemlerdir. Bu araştırmanın amacı fen bilimleri öğretmenlerinin sosyobilimsel bir konu olarak ele alınan aşı ile ilgili fikirlerini, aşı konusunun fen bilimleri eğitimi bağlamındaki önemine ve öğretim programına dahil edilmesine ilişkin görüşlerini araştırmaktır. Araştırma kapsamında uygun örnekleme yöntemi ile 49 fen bilimleri öğretmenine ulaşılmış olup, çevrimiçi olarak iletilen altı açık uçlu soruya yanıt vermeleri istenmiştir. Fen bilimleri öğretmenlerine günlük hayatta sıklıkla karşılaştığımız konuları sınıf ortamında öğrencilerle tartışma durumları sorulduğunda, çoğunluğunun sınıfında günlük konulara yer verdiği, öğretim programında olmadığı halde fen bilimleri ile doğrudan ilgili konuları öğrenme ortamına dahil edilmesiyle ilgili görüşleri sorulduğunda çoğu katılımcının bu konuları tartıştıklarını, aşı ile ilgili soru geldiğinde kolaylıkla cevap verebilme durumları sorulduğunda çoğunluğun kolaylıkla cevap verebilirim dediği tespit edilmiştir. Öğrencilerin aşılanma ile ilgili bilgileri bilmesi ve öğretim programına dâhil edilmesi ile ilgili görüşleri sorulduğunda 39 öğretmen 'evet konu önemli ve programa dahil edilmeli', yedi öğretmen 'hayır konu önemli değil ve programa dahil edilmemeli' ve iki öğretmen 'evet konu önemli ama programa dahil edilmemeli' olarak yanıtlamıştır. Aşı ile ilgili bir konu anlatırken zorluk yaşanması ile ilgili öğretmen görüşleri incelendiğinde 32 öğretmen zorluk yaşamayacağını belirtmiştir. Bu araştırmayla, aşı hakkında bilinçli tartışmaları kolaylaştırmada fen bilimleri öğretmenlerinin rolüne ve bu önemli konuyu fen bilimleri eğitimine entegre etmenin potansiyel faydalarına ışık tutmayı amaçlanmıştır. Araştırma sonuçları, fen bilimleri öğretmenlerinin müfredatta yer almayan ancak fen bilimleri ile ilgili olaylara/durumlara büyük oranda önem verdiklerini ortaya çıkarmaktadır. Dolayısıyla, gerekli düzenlemelerin yapılması koşuluyla aşı konusu gibi sosyobilimsel konuların müfredata dahil edilmesi önemlidir.

Anahtar Kelimeler: Aşı, Fen Bilimleri Eğitimi, Fen Bilimleri Öğretmenleri, Sosyobilimsel Konular

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1. Introduction

In a changing and developing world, the permanence of changes in individuals' behaviors, keeping pace with advancements, meeting the era's demands, and fostering research, inquiry, self-awareness, and self-confidence is achievable only through education. Faced with these shifts, numerous countries scrutinize their education systems and strategies, and are inclined toward cultivating novel perspectives. Science strives to observe, elucidate, and forecast occurrences, facts, and circumstances across various domains. This same pursuit is evident in the realm of science education. Put differently, investigations can be conducted concerning natural phenomena and entities in the environment, principles can be formulated, and prognostications can be derived from these principles (Kaptan & Korkmaz, 1999). Individuals who embrace science adeptly can dissect the quandaries prevailing in their societal milieu and generate solutions with a discerning outlook. In a milieu where such individuals coexist with society, an individual secures a foothold within that society, propelling them toward the swift evolution into a contemporary community (Temizyürek, 2003).

Education and training received at schools, along with the content of educational programs, play a crucial role in personal development. In essence, the foundation of any educational system lies in its curriculum (Yüksel, 2003). The primary goal of the science curriculum is to cultivate individuals with scientific literacy. Such individuals can critically observe problems and situations that arise in their daily lives and swiftly generate practical solutions to address these issues. Science education programs have undergone numerous revisions to nurture scientifically literate individuals. Notably, in the context of the 2013 Science Curriculum, the inclusion of "Socioscientific Issues" within the "Science-Technology-Society and Environment" domain, as well as the incorporation of "Science-Engineering-Technology-Society and Environment" in the 2018 Science Curriculum, hold significant importance. SSI are complex ethical dilemmas that lack straightforward solutions (Sadler, 2004). They are complex and controversial topics that involve scientific concepts and have social, ethical, and moral implications (such as climate change, genetic engineering, vaccination, stem cell research, biotechnology, etc.). These issues often lack clear-cut solutions and involve multiple perspectives. They require individuals to consider scientific evidence, societal values, and ethical considerations when making decisions or forming opinions (Eastwood et al., 2012; Sadler, 2004). However, not all subjects can be categorized as SSI. Two critical criteria should

be fulfilled to be labeled as a socioscientific subject. The first criterion involves a connection to scientific content, while the second criterion necessitates having social significance and relevance (Sadler, 2004; Topçu et al., 2014). SSI has gained substantial economic attention on a global scale. Significant funds have been allocated, particularly for addressing these controversial issues. Nevertheless, the Fukushima Nuclear Power Plant disaster in Japan in 2011 highlights that the public's perspective on these allocated funds may not always be favorable. This example underscores the need to integrate SSI into the science curriculum (Özhan, 2018; Topçu et al., 2014). The studies in science education literature emphasize the importance of integrating SSI into the learning environment (e.g., Sadler, 2011; Sıbıç, 2017; Topçu, 2010; Tosunoğlu & İrez, 2017). Accordingly, Sıbıç (2017) revealed that pre-service teachers who have a good command of SSI can comprehend and convey examples related to the topics faster than pre-service teachers who do not have a good grasp of these topics. Furthermore, a study by Tekin and Aslan (2019) highlights that pre-service science teachers tend to view SSI as more valuable and significant than pre-service social studies teachers. Another study conducted with students investigated the contribution of socioscientific subjects to field knowledge through an experimental approach. The results of this experimental study indicated that classes receiving science education based on socioscientific topics exhibited higher levels of success compared to the other classes (Pehlivan, 2020). Besides et al. (2019) also emphasized the importance of integrating SSI within the Science|Environment|Health (S|E|H) perspective. Among these significant SSI is the topic of anti-vaccine sentiment.

Anti-vaccination can be defined as individuals decline or oppose vaccination services for themselves and their children, even when available. Recently, there has been a noticeable increase in vaccine hesitancy within our country (Dolu et al., 2021) and European countries as well (Wise, 2021). Within the studies, it has been determined that despite the significant reduction of vaccine-preventable diseases globally, particularly in developed countries due to routine vaccination programs, many parents' concerns regarding vaccination persist (Yüksel & Topuzoğlu, 2019). A similar study conducted by Türkay et al. (2017) revealed that the presence of 6.2% of the participants identifying themselves as anti-vaccine individuals may indicate a potential rise in vaccine rejection. A study investigating vaccine rejections and the underlying causes found that parents' distrust of vaccines and fears of potential side effects were prominent factors (Hasar et al., 2021). Consequently, to counter these biases and concerns, it has been

recommended that educational and healthcare institutions provide comprehensive training with accurate information (Yüksel & Topuzoğlu, 2019). Once again, in recent history, during the COVID-19 pandemic, the most pressing issue of our time, new types of vaccine have emerged. However, these vaccines have triggered similar hesitations and fears among individuals (Fazel et al., 2021; Yılmaz et al., 2021). According to a study, 41.2% of respondents expressed a willingness to receive the COVID-19 vaccine, while 20.9% indicated that they would reject it, and 37.9% remained undecided regarding their decision (Yılmaz et al., 2021). Furthermore, Sandler et al. (2020) emphasized that college students have mixed attitudes about vaccines and lack knowledge of information about vaccination.

It is impossible to overestimate the importance of vaccinations in modern culture as a public health intervention. Infectious illness prevention and management have undergone a radical transformation since the development of vaccinations, saving countless lives and significantly enhancing global health. Due to the COVID-19 pandemic, the significance of vaccines has come to light in public conversation, emphasizing the need for an informed populace. Nevertheless, there is a remarkable gap in the science education curriculum despite the vaccines' critical role. There is a noteworthy lack of information about vaccination in many educational systems, including science curricula in Türkiye. Although biology, chemistry, and physics concepts are frequently included in science curricula, the issue of vaccination is glaringly absent from the program. Science education plays a pivotal role in shaping individuals' understanding of the world and their capacity to engage with complex scientific and public health issues. The absence of vaccination-related issues from the curriculum deprives students of critical information that may enable them to make wise health decisions and participate in public health conversations. A comprehensive review of the science curriculum reveals a consistent gap in the coverage of vaccination-related content (MEB, 2018). The established curricula noticeably miss out on subjects like vaccine development and history, mechanisms of vaccine action, the value of herd immunity, and the function of vaccines in disease prevention. Absence of the vaccination-related content from the science curriculum is not solely an educational concern; it has also tangible consequences for public health. Making informed vaccination decisions is essential for overcoming vaccine reluctance and achieving high immunization uptake rates. As students mature into adults, their knowledge—or lack thereof—of vaccination directly affects their willingness to get immunized and their support for vaccination policy. In

order to encourage informed decision-making, overcome vaccine hesitancy, promote a population that actively engages with public health issues, and understand the nature of science, it is inevitable to address this shortcoming by incorporating thorough and accurate information regarding vaccination into science curricula. Accordingly, Dillon and Avraamidou (2020) discussed the role of science education in the context of COVID-19 pandemic and a vision of science education should be shaped in this post-pandemic era. Science education should provide answers to students who have concerns about vaccination and students should find their way in the light of scientific knowledge. To address the lack of information about vaccinations in the science curriculum, beforehand, it is critical to assess how prepared science teachers are to include this important topic in their lessons. A critical evaluation of the readiness of science teachers should be conducted to understand their perspectives and varying degrees of preparedness.

Therefore, the purpose of this study is to investigate insights into science teachers' perspectives on the topic of vaccination and its potential integration into the science curriculum. In this current study, science teachers' views will be understood by exploring their beliefs and knowledge regarding vaccination, including their opinions on its significance in the context of science education. Additionally, in case of integration of the vaccination topic into the science curriculum, their preparedness will be assessed in addressing questions and concerns related to vaccination when raised by their students. This includes evaluating their self-perceived competence in providing accurate information and fostering informed discussions. Then, the study will provide valuable insights and recommendations to curriculum developers, educational policymakers, and teacher training programs on the inclusion of vaccination-related content in the science curriculum based on science teachers' perspectives.

2. Method

This study employed a qualitative research method to elucidate teachers' perspectives regarding the utilization of vaccination and their opinions on integrating these topics into the science curriculum. In qualitative research, information can be directly obtained from individuals, allowing them to express their thoughts openly. In this study, a case study from a qualitative approach is used to explore the science teachers' views on vaccination that are not easily quantifiable, and a deeper understanding of science teachers' perspectives is needed

(Patton, 2202). The case study methodology remains closely aligned with its fundamental values and purposes (Merriam, 2009). The case of this study was in-service science teachers' perspectives about SSI, specifically vaccines, and the research question was designed based on this case; the social constructivist paradigm was situated to gather rich, context-specific data (Merriam, 2009).

2.1. Participants

The participants of this study were science teachers who were employed in different cities around Türkiye. Thus, the unit of analysis of this case study was in-service science teachers whose perspectives were investigated in terms of SSI, vaccination, and integration of the topic into the science curriculum. The participants were determined using a convenience sampling method involving 49 in-service science teachers (Fraenkel, & Wallen, 2009). All participants shared a common experience, teaching during the COVID-19 pandemic. The participants have a minimum of one and a maximum of twenty years of teaching experience in public schools in different cities. The demographic characteristics of the teachers are presented in Table 1.

Table 1.

Participants demographic characteristics

Gender	Frequency	Age Mean	Teaching Experience (years) Mean
Female	40	30.01	6.46
Male	9	35.56	12.22
Total	49	31.08	7.66

2.2. Data Collection

A question form was utilized as the primary data collection instrument in this research, designed by the authors. The beginning part of the question form encompassed inquiries concerning the demographic characteristics (such gender, teaching experience, school type that they teach, etc.) of the participating science teachers. Within the form, science teachers were consulted on their perspectives concerning the inclusion of SSI in their teaching/learning environment and the potential integration of topics like vaccination into the science curriculum. To formulate open-ended questions, an initial examination of the science curriculum was conducted to identify any existing content related to vaccination. No information regarding vaccination was identified within the curriculum. Subsequently, the questions were crafted in alignment with the research objectives. To ensure the appropriateness, clarity, and structure of

these questions, the questions were reviewed by two experts in the field of science education and two in-service science teachers. After making the suggested minor changes, the questionnaire was pilot tested with one in-service science teacher to ensure clarity, relevance, and coherence. Subsequently, the final version of the questionnaire was uploaded to Google Forms, and the questionnaire's link was distributed to in-service science teachers through social media channels. It typically takes participants approximately 30 to 45 minutes to complete all the questions.

The final question form consisted of two sections. The first section comprised the initial four questions, which gathered personal information, including school, age, gender, and years of teaching experience. Following these demographic questions, the questionnaire included six open-ended questions that explored the teachers' perspectives on SSI, with a specific focus on vaccination and its potential integration into the science curriculum. Some sample questions included: “Do you actively discuss topics commonly encountered in daily life with your students in the classroom?” or “When your students ask you a question about vaccination, do you feel confident in providing clear answers?”

2.3. Data Analysis

In this section, the data analysis is presented about the collected data from science teachers regarding their ideas and perspectives on vaccination. Science teachers wrote their ideas in the Google form and their responses were collected as qualitative data based on the open-ended questions. Therefore, the dataset included qualitative responses from the form. The data collected in the current research were analyzed using a qualitative approach which is a descriptive analysis method to provide a comprehensive understanding of science teachers' ideas and perspectives on vaccination, including calculations of percentages and frequencies. Before the analysis, the science teachers’ responses from the form were organized and anonymized to ensure confidentiality and facilitate the analysis process. Two researchers independently analyzed the data, first, the responses were reviewed to become familiar with the content and gain an initial understanding of the science teachers' perspectives on vaccination. Then, the codes, which were mainly inductive, were generated for segments of data that represented similar ideas or concepts. Additionally, some selected quotations from science teachers' responses were included to provide context for the findings. Then, the

relationships between codes and categories were investigated to identify patterns and insights within the data. The authors analyzed the data individually; afterward, the results were compared to resolve any discrepancies and ensure reliability and discussed to reach a consensus. Finally, the results were then recorded in the form of a frequency table.

3. Results

This section presents the teachers' views regarding vaccination based on the analysis of the collected data. The results are presented in the following section.

The science teachers were asked whether they were discussing the issues frequently encountered in daily life with students in the classroom environment. Their responses are given in Table 2. The table reveals that 41 science teachers incorporated everyday topics into their learning environment, while two frequently integrated them. Additionally, three science teachers occasionally included these topics, one science teacher did so infrequently, and two science teachers did not include them at all. One of the participant science teachers (Teacher 42) said, *"Yes, I address these topics using various approaches, particularly based on the grade levels. I also provide very instructive returns for myself."* Another participant (Teacher 39) expressed, *"Certainly. Keeping things up-to-date is crucial."*

Table 2.

Teachers' responses on discussing the issues frequently encountered in daily life with students in the classroom environment

Do you actively discuss topics commonly encountered in daily life with your students in the classroom?	f	%
Yes	41	83,67
Often	2	4,08
Sometimes	3	6,12
Rarely	1	2,04
No	2	4,08
Total	49	100

As a second question, teachers were asked their perspectives on incorporating science-related events/situations that fall outside the curriculum into the learning environment. Table 3 presents the teachers' perspectives regarding the incorporation of science-related events/situations into the learning environment, even if they are not part of the curriculum. Out of the total, 48 teachers indicated that they integrate these topics into the classroom, while one teacher stated otherwise. Here are some of the opinions expressed on this matter:

Teacher 9 "Yes, I do. Even if they are not part of the official curriculum, I make sure to discuss science-related topics from daily life in the classroom."

Teacher 10 "Absolutely, I do. By emphasizing that science is inherent to life itself, I consistently provide examples from everyday life, fostering a context-based learning environment."

Teacher 21 "Yes, I engage in this practice. Science is intricately connected to daily life, and if I only impart textbook knowledge to children, it becomes a mere lesson. By linking it to their everyday experiences, it becomes more engaging and memorable."

Teacher 29 "Indeed, I do. For instance, when explaining mutations, I discuss Covid-19, a topic frequently encountered in our daily lives. I also use the development of vaccines as an example of biotechnology."

Table 3.

Teachers' responses on incorporating science-related events/situations that fall outside the curriculum into the learning environment.

Do you introduce events/situations that are not covered by the curriculum but are related to science into the learning environment?	f	%
Yes	48	97,95
No	1	2,04
Total	49	100

The next question was about whether the teacher could confidently answer students' questions about vaccination. In Table 4, the teachers' capability to respond easily when their students inquire about vaccination is presented. The data indicates that 32 teachers responded positively, affirming they can readily address the queries. On the other hand, nine teachers acknowledged that they can sometimes answer easily, while eight teachers expressed that they cannot readily respond. Some individual perspectives on this matter are outlined below:

Teacher 38 "Yes, I can easily answer their questions about vaccination. I have a good understanding of the topic due to my interest and the extra reading and research I've done."

Teacher 42 "Yes, I can easily answer their questions. I believe that teachers should be knowledgeable about current issues and provide accurate information to students. If I am unsure about a specific detail, I tell them I will look it up and provide accurate information later. And added that they can investigate the issue in-depth with their parents."

Teacher 21 "I sometimes find it challenging because I'm not familiar with every vaccine. While I know what a vaccine is for and its intended purpose, I might struggle to answer questions about administering specific vaccines. I lack knowledge in this area."

Teacher 23 "I might face challenges in answering certain questions, as the details of vaccine contents, stages, trials, and launch are not always transparent or easily accessible."

Table 4.

Teachers' responses on responding to students' questions about vaccination.

When your students ask you a question about vaccination, do you feel confident in providing clear answers?	f	%
Yes	32	65,30
Sometimes	9	18,36
No	8	16,32
Total	49	100

The following question was about what prerequisite knowledge they think students should have in order to learn about vaccination. Table 5 presents teachers' perspectives regarding the prerequisite knowledge that students should possess to comprehend the significance of vaccination. The table reflects that among the participating teachers, three teachers emphasized the importance of understanding the health of systems, four teachers considered prior knowledge of biotechnology, 13 teachers pointed toward a comprehension of microscopic living organisms, and 17 teachers underscored awareness of the effects of vaccines. Furthermore, four teachers stated that understanding vaccination methods was essential, while one advocated for experiential knowledge. Similarly, one teacher stressed the necessity of vaccination only when required, and six teachers highlighted the importance of immunity. Additionally, two teachers elaborated on the role of white blood cells, one teacher discussed cells and microorganisms, one teacher addressed the circulatory system, and one teacher described the concept of the body's defense mechanisms. Three teachers suggested familiarity with infectious diseases as a prior knowledge requirement. Lastly, two teachers did not provide a response to this question. Below are a few sample responses to the question:

> **Teacher 2** "They should understand the benefits of vaccination."
>
> **Teacher 15** "They should have a strong grasp of biotechnology."
>
> **Teacher 29** "They should be aware of the technical methods used to create vaccines and understand that these methods have been employed against diseases for an extended period."
>
> **Teacher 32** "They should be familiar with body systems and their health. Additionally, having knowledge of technology and biotechnology would be supportive."
>
> **Teacher 41** "They should have a basic understanding of the immune system and how it works."

Table 5.

Teachers' responses on prerequisite knowledge that students should possess to comprehend the significance of vaccination.

What pre-knowledge do you think students should have in order to learn about vaccination?	f	%
The effects of vaccines	17	28,81
Microscopic living organisms	13	22,03
Importance of immunity	6	10,16
Biotechnology	4	6,77
Vaccination methods	4	6,77
Health of systems	3	5,08
Infectious diseases	3	5,08
White blood cells	2	3,38
Experiential knowledge	1	1,69
Necessity of vaccination	1	1,69
Cells and microorganisms	1	1,69
The circulatory system	1	1,69
The body's defense mechanisms	1	1,69
No response	2	3,38
Total	59*	100

**Some teachers gave multiple responses.*

The next question was about the opinions of teachers about the importance of informing students about vaccination and whether the subject of vaccination should be included in the curriculum. In Table 6, teachers' opinions regarding the importance of students' understanding of vaccination and its incorporation into the curriculum were collected. Upon examining the provided responses, 39 teachers expressed that the subject is significant and should be included in the curriculum, while seven teachers held the view that the subject is not important and shouldn't be part of the curriculum. Additionally, two teachers indicated that the subject is important but shouldn't be included, and one teacher remained undecided on this matter. Here are a few examples of the responses provided by the teachers on this subject:

> **Teacher 5** "It's important, and it should be included. Students should be aware of both the benefits and potential risks of vaccines."
>
> **Teacher 8** "Yes, especially given the increase in epidemics, understanding the importance of vaccines is crucial."
>
> **Teacher 21** "Certainly. When I was a child, we used to get vaccinations at school, but I never really understood why or why it was only during our early years. I would appreciate understanding the reasons at that time. While I believe experiential learning is valuable, I also think it's important to comprehend the rationale behind what we experience."
>
> **Teacher 29** "Parents should be the ones informed about this issue rather than students. Hence, I don't believe it should be integrated into the curriculum."

> **Teacher 35** "The topic of vaccination doesn't necessarily need to be included in the curriculum. It's more important for parents to receive information about whether to vaccinate or not."
>
> **Teacher 39** "Yes, it's definitely important. Yes, it could be incorporated into the curriculum. Throughout the coronavirus pandemic, I encountered numerous anti-vaccine arguments, often presented in a science fiction-like manner. I strongly believe this arises from a lack of understanding."
>
> **Teacher 40** "Certainly, it holds great importance. Diseases that have been eradicated through vaccination should be explained, along with the historical context. The impact of a pandemic, which these children have experienced, could be highlighted. Our transformed way of life, largely due to vaccination, stands as the closest and most relevant example."

Table 6.

Teachers' opinions regarding the importance of students' understanding of vaccination and its incorporation into the curriculum.

Do you think it is important for students to be informed about vaccination? Do you think the subject of vaccination should be included in the curriculum?	f	%
Yes, it should be included.	39	79,59
No, it shouldn't be included.	7	14,28
Yes, but shouldn't be included.	2	4,08
Undecided	1	2,04
Total	49	100

Followingly, the teachers were asked their opinions about the appropriate grade level and subjects for including vaccination in the science curriculum. In Table 7, teachers' views about the appropriate grade levels and subjects for including vaccination in the science curriculum are examined. From the responses, it is evident that five teachers suggested that vaccination should be taught at 'all levels of elementary school'. Additionally, five teachers believed it should be taught in 'Grade 8: Living Things and Life', ten teachers recommended 'Grade 6: The Health of Systems', and ten teachers favored 'Grade 8: DNA and Genetics'. Furthermore, two teachers indicated 'Grade 5: Let's Get to Know Living Things', while one teacher suggested it should be taught at the end of primary and secondary school. Another teacher mentioned 'Grades 4 or 5', and one teacher expressed 'Grade 5' as appropriate. There were suggestions for specific subjects, such as 'Grade 5: Technology and Health', 'Grade 6: Circulatory System', 'Grade 7: Cell', 'Grade 8: Nutrition and Health', and 'Grade 9: Biology'. It's important to note that 12 teachers (22.64%) did not respond to this question. Examples of teachers' responses are presented as follows:

> **Teacher 10** "It could be included in the 6th-grade curriculum as part of the "Our Body Systems and Health" unit."

> **Teacher 32** "The 6th and 8th grades are more suitable for discussing epidemics and diseases due to their subject distribution. However, 5th graders might show a heightened interest in the context of technology and health."
>
> **Teacher 33** "Biotechnology in the 8th grade DNA and Genetics unit can be given in more detail."
>
> **Teacher 41** "Previously, it was covered under the topic of the immune system. Although this subject was removed later, it could potentially be included in the 6th-grade curriculum."
>
> **Teacher 42** "It could be appropriate to include it under the topic of health in the 2nd unit of the 5th Grade curriculum, titled "Let's Get to Know Living Things."

Table 7.

Teachers' views on the appropriate grade level and subjects for including vaccination in the science curriculum.

If your answer to the previous question is yes, in which context do you think vaccination should be included in the program? What grade level and subjects do you think it is appropriate for?	f	%
Grade 6: The Health of Systems	10	18,86
Grade 8: DNA and Genetics	10	18,86
All levels of elementary school	5	9,43
Grade 8: Living Things and Life	5	9,43
Grade 5: Let's Know Living Things	2	3,77
At the end of primary and secondary school	1	1,88
Grades 4 or 5	1	1,88
Grade 5	1	1,88
Grade 5: Technology and Health	1	1,88
Grade 6	1	1,88
Grade 6: Circulatory System	1	1,88
Grade 7: Cell	1	1,88
Grade 8: Nutrition and Health	1	1,88
Grade 9: Biology – Viruses	1	1,88
No response	12	22,64
Total	53*	100

**Some teachers gave multi responses.*

The last question was whether they would face any challenges while teaching the topic of vaccination. Table 8 presents the teachers' responses regarding challenges in explaining topics related to vaccination. The results revealed that six teachers found the topic challenging, 32 teachers did not foresee any challenges, and eleven teachers mentioned potential challenges. Some examples of teachers' responses are provided below:

> **Teacher 10** "No, I won't have difficulties. I can provide information about vaccines using scientific journals in the classroom, and I can assist students in developing awareness by showing videos from experts in the field of medicine."
>
> **Teacher 29** "Maybe, I can face some difficulties, as I don't typically delve into technical articles on this topic."

Teacher 32 "Certainly not. We integrate real-life situations into our lessons, which often result in engaging and enjoyable moments. The concept of an epidemic can be divided into endemic and pandemic occurrences. The awareness of families will largely depend on children, especially if our country faces a problem or a global pandemic reemerges."

Teacher 33 "Yes, we can have difficulties. As Science Teachers, we should have received more comprehensive training on this subject during our university studies."

Teacher 38 "I don't believe so. However, I do make sure to caution my students about urban legends, which are false pieces of information, such as claims about microchipping."

Teacher 49 "Partial difficulties might be encountered, as not everyone is well-informed about vaccination, leading to potential biases or misconceptions against vaccination."

Table 8.

Teachers' responses regarding challenges in explaining topics related to vaccination.

Will you face any challenges while teaching the topic of vaccination?	f	%
Yes, I would.	6	12,24
No, I wouldn't.	32	65,30
Maybe, I would.	11	22,44
Total	49	100

4. Discussion and Conclusion

SSI are often regarded as fundamental aspects of science education. While it may not always be explicitly included in the formal curriculum, it is evident that these issues find their way into the classroom environment, where educators frequently incorporate them into their lessons. The results of this study revealed that science teachers give importance to events/situations not covered by the curriculum but related to science. Some science teachers mentioned that they took the initiative to explore some topics independently, incorporating these discussions into their lessons, even though it's not mandated by the curriculum. This highlights the practical importance of SSI in science education. The study by Yıldırım and Bakırcı (2020) underscores the significant role of SSI in enhancing students' comprehension of problems, events, and situations. They emphasize the importance of incorporating these issues more frequently into the curriculum, provided that necessary adjustments are made.

The topic of vaccination is indeed crucial and has gained even more significance in recent times, particularly in this COVID-19 pandemic era. Although this topic is not covered by the middle school science curriculum, it has been a hot topic in recent times, leading to many student questions about it. In addition, in the classroom environment, science teachers might come

across students who reject vaccines or are hesitant about vaccines, for sure. To answer students' questions or relieve them about their concerns, science teachers should have a basic understanding of vaccines and the ability to provide accurate answers to their students' questions or point them to trusted sources to get information to understand the nature of science. This not only promotes understanding but also helps address concerns and misconceptions related to vaccination, contributing to public health education. The science teachers in this current study expressed their perspectives on vaccination and integration of it into the science curriculum. Most of science teachers acknowledged the pressing need for comprehensive vaccination content within the science curriculum, especially in light of recent global health events like the COVID-19 pandemic. The study conducted by Girgin et al. (2023) reveals that teachers harbor a certain degree of mistrust regarding vaccines, and this mistrust is rooted in a lack of knowledge. This finding underscores the importance of providing teachers with accurate and comprehensive information about vaccines, as well as the significance of incorporating vaccination-related topics into science curricula to foster a better understanding of this critical public health issue among both teachers and students. In this study, teachers were asked two important questions: " When your students ask you a question about vaccination, do you feel confident in providing clear answers?" and " Will you face any challenges while teaching the topic of vaccination?" While a significant number of science teachers expressed their willingness to include vaccination-related content in their teaching, there are variances in their readiness levels. When analyzing the reasons behind their responses, it's notable that while a majority of teachers expressed confidence in their ability to address vaccination-related questions and teach the subject effectively, a significant portion of teachers acknowledged the possibility of encountering difficulties. In other words, not all science teachers felt equally equipped to address vaccination topics, some expressed their concerns about their own knowledge gaps regarding vaccines and may seek further training or resources to enhance their expertise.

The study highlights a crucial issue concerning the confusion and questions surrounding vaccines, primarily attributed to the lack of comprehensive education on this subject. The findings indicate that there is a need for students to possess some essential background knowledge about vaccines. According to the teachers surveyed, this preliminary knowledge should encompass information about the effects of vaccines, microscopic organisms, and

immunity. This observation aligns with the suggestion made by Yüksel and Topuzoğlu (2019), emphasizing the importance of incorporating detailed information about vaccines into accessible sources. Such information should cover the benefits, potential side effects, and the components of vaccines. This approach aims to equip individuals with accurate and reliable information, enabling them to make informed decisions regarding vaccination and counteracting the spread of misinformation often encountered on social media platforms.

The persistence of anti-vaccine views, even in an age of advanced technology, is indeed a concerning issue. This study underscores the critical role of education in addressing this problem. The reasons for hesitancy or vaccine rejection may vary. For instance, Sandler et al. (2020) emphasized the lack of knowledge of college students and Türkay et al. (2017) highlighted the major reasons for vaccine rejection were the spread of false news and political discourse in the media. This study (Türkay et al., 2017) also underscores the significance of education in struggling with vaccine misinformation and the importance of understanding the nature of science. In the current study, teachers were asked about the importance of students being informed about vaccination and whether vaccination should be included in the curriculum. The majority of teachers expressed that topics are important, and the topic of vaccination should be a part of the curriculum. Based on science teachers' responses, this study strongly recommended including the vaccination concept in the science curriculum. Similarly, as mentioned in Siani, Carter, and Moulton (2022), the results emphasize the need to guarantee that secondary school curricula comprehensively address crucial public health topics. Additionally, it is essential to equip both learners and educators with an adequate level of scientific and digital literacy to guide their decision-making regarding vaccinations (Siani et al., 2022). However, it's also necessary to mention that education alone might not be adequate, and it may need to be complemented by other strategies to address the complex issue of vaccine hesitancy or rejection. Zeyer and Dillon (2019) suggested that the science curriculum should be considered within the Science|Environment|Health (S|E|H) perspective. With the introduction of the S|E|H perspective, many researchers have used teaching approaches (e.g., Byrne et al., 2014; Cetin-Dindar, 2015), curriculum (e.g., Simon et al., 2016), and textbooks (e.g., Hoffer, Lex, & Simon, 2022) within the light of S|E|H perspective (Cetin-Dindar, 2022). Besides, based on the findings of this study, the vaccination concept can be included in the science curriculum, addressing the role of vaccination during pandemics. In order to achieve the goals

of science education and promote citizenship, teachers can leverage their expertise and past experiences to discern the aspects that merit discussion within particular contexts when working with specific groups of students (Justi et al., 2022). It is crucial that students not only grasp the importance of vaccination but also acquire basic knowledge about viruses, their transmission, and the science behind vaccines with an understanding of the nature of science (Reiss, 2022; Weisberg et al., 2021).

4.1. Implications of Research

This research on vaccination in the context of science education carries far-reaching implications for curriculum development, teacher training, public health, and community engagement. It emphasizes the importance of comprehensive vaccination education in shaping informed citizens and fostering a healthier society. The study underscores the need for an enriched science curriculum that incorporates socioscientific topics such as vaccination. By doing so, students can receive a more holistic education that equips them with the knowledge and critical thinking skills necessary to engage with real-world issues. The findings highlight the importance of providing science teachers with the necessary training and resources to confidently discuss vaccination topics in the classroom. Graduate student programs can empower teachers to effectively address students' inquiries and concerns about vaccination. Collaboration between science educators, health professionals, and policymakers is vital. This research emphasizes the need for interdisciplinary efforts to develop comprehensive educational programs and policies related to vaccination. Educational institutions should recognize the evolving nature of vaccination and public health challenges. The curriculum should remain adaptable to address emerging issues and new vaccines, fostering a lifelong commitment to informed decision-making.

Integrating vaccination topics into the science curriculum can contribute to better health literacy among students. This can empower them to make informed decisions about their health and vaccination, ultimately leading to improved public health outcomes. The study suggests that education about vaccination should extend beyond the classroom to engage parents and the broader community. This can help dispel myths and misconceptions, fostering a more supportive environment for vaccination.

The study highlights the potential for further research on the effectiveness of integrating vaccination topics into the science curriculum. This could involve longitudinal studies to assess the long-term impact on students' knowledge and attitudes toward vaccination. As discussions about vaccination can be sensitive and value-laden, educators should be prepared to address ethical aspects in the classroom. This research highlights the importance of including ethical discussions in vaccination education.

4.2. Suggestions

Addressing the following suggestions could contribute to a more comprehensive and nuanced understanding of the role of science teachers in vaccination education. The main suggestion of this study is the relatively small sample size of in-service science teachers involved. While efforts were made to reach a diverse group (such as more experienced, different locations, etc.), the findings may not be fully representative of all science teachers' perspectives on vaccination. Future research could involve a larger and more diverse sample of science teachers, potentially from different countries or regions. This would enhance the generalizability of findings. Combining quantitative data from questionnaires with qualitative data from interviews or focus groups could offer a more comprehensive understanding of science teachers' perspectives on vaccination. Long-term studies tracking changes in science teachers' perspectives and practices regarding vaccination could provide valuable insights into the impact of evolving scientific knowledge and educational policies.

Comparing the perspectives of science teachers with those from other disciplines or comparing teachers from different countries could reveal variations in attitudes and practices related to vaccination education. Designing and implementing educational interventions on vaccination within teacher training programs and assessing their impact on teachers' knowledge and practices would be beneficial for both research and practice. Also, investigating students' perceptions and understanding of vaccination and related topics could complement teacher-focused research, providing a more holistic view of science education's effectiveness in this area.

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Research Article

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Investigation of Higher Education Students' Use of Learning Strategies in Distance Education

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Abstract

In addition to developing learning strategies, it is essential to determine students' mastery of these skills. In this context, the purpose of this study is to adapt into Turkish the instrument developed by Meijs et al. (2019) to determine the use of learning strategies required by learners in distance education environments. The second objective is to analyze the data to be obtained from the adapted scale in terms of multiple variables and to disclose the status of students' use of learning strategies in environments of distance education in Turkey. In this research, a survey study design was used to fully reveal the learning strategies that students use for distance education. The Motivated Strategies for Learning Questionnaire Part B Distance Education (MSQL-B DE) scale and a personal information form containing demographic and other student information served as data collection instruments. In this research, both EFA and CFA were applied. Additionally, the parameters derived from Confirmatory Factor Analysis indicated that the model was compatible. Complex cognitive strategy use has the highest mean when the findings are analyzed according to the means. Simple cognitive strategy use, academic thinking, and time, resource, and effort management are the respective strategies used. Compared to the other strategies, communication with others was determined to be the least utilized. The results of the study contain as many diverse elements as possible in accordance with the literature on the application of learning strategies in the distance education process. In future research, it may be possible to investigate various aspects of learning strategies in distance education, including course processing and academic achievement.

Keywords: Keyword, Learning Strategies, Distance Education, Higher Education, Factor Analysis

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Yükseköğretim Öğrencilerinin Uzaktan Eğitimde Öğrenme Stratejilerini Kullanma Durumlarının İncelenmesi

Özet

Öğrenme stratejilerinin geliştirilmesi kadar öğrencilerin bu becerilere ne düzeyde sahip olduklarının belirlenmesi de önemlidir. Bu kapsamda çalışmanın amacı, uzaktan eğitim ortamlarındaki öğrenenlerin ihtiyaç duydukları öğrenme stratejilerinin kullanım durumunu belirlemek için Meijs ve arkadaşları (2019) tarafından geliştirilen aracı Türkçe'ye uyarlamaktır. İkinci amaç ise, uyarlanan ölçekten elde edilecek verileri çeşitli değişkenler açısından analiz ederek Türkiye'deki uzaktan eğitim ortamlarında öğrencilerin öğrenme stratejilerini kullanma durumlarını ortaya koymaktır. Bu çalışmada, öğrencilerin uzaktan eğitime yönelik kullandıkları öğrenme stratejilerini tümüyle ortaya koymak amaçlı tarama çalışması deseni kullanılmıştır. Araştırmada veri toplama aracı olarak, öğrencilerin demografik ve diğer bilgilerini içeren kişisel bilgi formu ve MSQL-B DE ölçeği kullanılmıştır. Bu çalışmada AFA ve DFA birlikte kullanılmıştır. Doğrulayıcı Faktör analizinden elde edilen parametreler de modelin uyumlu olduğunu göstermiştir. Bulgular incelendiğinde ortalamalara göre karmaşık bilişsel strateji kullanımı en yüksek ortalamaya sahiptir. Basit bilişsel strateji kullanımı, akademik düşünme ve zaman, mekân ve çaba yönetimi sırasıyla kullanılan stratejilerdir. Başkalarıyla iletişim stratejisi diğerlerine göre en az kullanılan strateji olarak belirlenmiştir. Araştırmanın sonuçları uzaktan eğitim sürecinde öğrenme stratejilerinin kullanımı konusunda literatürden edinilen veriler doğrultusunda farklı öğelerle mümkün olabildiğince zengin bir içerik sağlamaktadır. Gelecek çalışmalarda uzaktan eğitimde öğrenme stratejilerine yönelik farklı öğelerin çalışılması durumu söz konusu olabileceği gibi işin içerisine ders işleme süreci ve akademik başarı gibi etkenler de dahil edilebilir.

Anahtar Kelimeler: Öğrenme Stratejileri, Uzaktan Eğitim, Yükseköğretim, Faktör Analizi

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1. Introduction

There is considerable research on learning strategies, their impact on learning, and their relationship with instructional contexts based on more than 50 years of study history. One reason is that learning strategies encompass all cognitive, affective, and behavioral processes that help students regulate and learn well (Kizilcec et al., 2017). Another factor that contributes to its popularity is the recognition that learning strategies (Rachel et al., 2007), also known as the methods and techniques that students use to improve their learning, are not an innate ability but can be learned through experiences (McKeachie, 1988), and have a developable structure (Mayer, 1988). Learning strategies have been reported to be related to academic achievement (Broadbent & Poon, 2015; Cook et al., 2013; El-Adl & Alkharusi, 2020; Ergen & Kanadli, 2017), motivation (Ames & Archer, 1988; Al-Qahtani, 2013), language learning (Al-Qahtani, 2013; Lin et al., 2017), recall (Goverover et al., 2011; Sankaran & Bui, 2001), problem-solving (Lazakidou & Retalis, 2010; Puteh & Ibrahim, 2010). According to the literature, using learning strategies contributes to learners becoming more effective learners.

In addition to developing learning strategies, determining the extent to which learners acquire these skills is critical (Meijs et al., 2019; Van Hout-Wolters, 2009). Teachers, for example, can use this knowledge to guide learners when needed (Artino & Stephens, 2009), learners can use this knowledge to increase their learning efficiency (Credé & Phillips, 2011), and the level of use of the appropriate teaching method or educational technology in an academic program can be determined using this knowledge (Duncan & McKeachie, 2005). As a result, numerous measurement tools have been developed to identify learning strategies for a wide range of learning objectives, educational levels, and age groups (Duncan & McKeachie, 2005; Pintrich et al., 1993; Shraw & Dennison, 1994; Van Hout-Wolters, 2009; Weinstein et al., 1987).

Based on social cognitive theory, the Motivated Strategies for Learning Questionnaire (MSLQ) developed by Pintrich et al. (1993) is a widely used measurement tool in the literature. Part B of the scale consists of 50 items, three main dimensions and nine sub-dimensions: cognition, metacognition and resource management, which cover only learning strategies. Cognition strategies consist of iteration, paraphrasing, organizing and critical thinking; metacognition strategies consist of planning, monitoring and organizing; and resource management strategies

consist of time-study environment, effort, peer collaboration management and asking for help. There are various versions of the scale for different educational levels.

Distance education is becoming more common globally (Allen & Seaman, 2017; Williamson et al., 2020), and its resources are growing constantly (Seaman et al., 2018). The main reasons for this situation are that employees need continuous education (Clariziaet al., 2021; Kyndt et al., 2011), the need for lifelong learning is accepted by large segments of society (Ates & Alsal, 2012), and distance education has become inevitable in extraordinary situations such as epidemics and disasters (Williamson et al., 2020). In addition, distance education supports individual and social development by providing opportunities such as educational equality, efficient use of resources, and learning independent of time and place (Simonson et al., 2015). In addition to these contributions, Meijs et al. (2019) argue that students' use of learning strategies is even more crucial for the effective maintenance of distance education than face-to-face education. Distance education environments may differ from face-to-face teaching with their aged participants, who have various responsibilities other than being a student and with their working mass (Simonson et al., 2015). Therefore, the anticipated learning strategies of students who receive face-to-face education versus those who receive distance education are distinct (Meijs et al., 2019). This situation necessitates the development of a distance education-specific instrument for measuring learning strategies.

Meijs et al. (2019) revealed that the MSLQ tool developed by Pintrich et al. (1993) was unsuitable for determining learning strategies in distance education environments. They made some adjustments to the factors and items of the original scale. After factor analysis, they created a valid and reliable tool for determining learning strategies in distance education environments. The new instrument consists of five factors and 25 items: time, resource, and effort management; complex cognitive strategy use; simple cognitive strategy use; communication with others; and academic thinking.

Two aims are present in this study. A Turkish language scale for assessing learning strategies in distance education environments needs to be available. The primary objective is to translate and culturally adapt the MSLQ B (DE) scale, developed initially by Meijs et al. (2019), to assess the utilization of learning strategies in distance education in the Turkish language. Furthermore, this scale acquired a valid and reliable instrument for future investigations on

learning strategies among diverse sample populations. The second goal is to examine the data generated by the adapted scale in terms of various variables to show the state of students' use of learning strategies in distance education environments in Turkey. Hence, the outcomes derived from a cohort of 609 participants were presented. The following research questions are being asked in accordance with these aims:

- *What is the factor structure of the measurement tool adapted to Turkish to determine the use of learning strategies for distance education?*
- *Does the students' learning strategy usage status differ according to the department, gender, course follow-up tools, participants' teaching method preference, key factors in the distance education, participation in extracurricular activities, and participants' weekly study hours?*

2. Background

2.1. Learning Strategies

Students employ various learning strategies to manage their academic goals, accomplishments, and learning methods (Neroni et al., 2019). Mayer (1988) describes these tactics as behaviors set to dictate the way students handle and utilize information. In their research, Weinstein and Underwood (1985) discussed the term "learning strategies," highlighting methods deemed essential or beneficial by experts for efficient learning and knowledge application. Further elaborating, Weinstein and Mayer (1986) explained these strategies as internal and external activities impacting a learner's motivation, focus, and the way they select and process information. Simply put, the methods involved in organizing, converting, transporting, and applying knowledge are termed learning strategies (Alexander et al., 1998).

Students are expected to be autonomous in their learning processes, to utilize learning tools, and to absorb the information in educational systems. An efficient learning process in and out of school is only possible if students can initiate, direct, and regulate the search for knowledge, as well as process and store this knowledge (Wegner et al., 2013). Learning strategies are essential in managing these processes. Learning strategies are essential to academic performance because they allow individuals to design, monitor, and assess their own learning process (Wegner et al., 2013). According to Donker et al. (2014), it is critical for both the student

and the teacher to identify which learning approach the student will utilize and which will be useful to him/her. Students' usage of learning strategies can help them achieve their objectives (Meijs et al., 2019). Students who understand how to study in a way that ensures that the knowledge and abilities they acquire are permanent will find it easier to learn (Weinstein & Underwood, 1985). Using metacognitive learning strategies to assist active learning has recently become a trend and an innovation in instructional design (Bakar & Ismail, 2020). Learning strategy is acknowledged as a predictive element for students' learning outcomes since an effective learning strategy is always associated to academic accomplishment (Jamaluddin et al., 2021).

Self-regulated learning, which is the process through which students initiate and sustain cognitive activities to attain learning goals (Schunk, 2005; Zimmerman, 2002), is a component of learning techniques. Duncan and McKeachie (2005) classify learning strategies into three categories (Pintrich et al., 1993). These include cognitive, metacognitive, and resource management. Cognitive learning strategies boost students' ability to comprehend material more thoroughly, transfer and apply knowledge to new contexts, and result in more effective and lasting learning (Winn et al., 2019). Cognitive learning strategies include rehearsal strategies, organizational strategies, and elaboration strategies. Extensive research on the effectiveness of cognitive learning strategies shows that using them helps students control their learning processes and improves their outcomes (Hattie et al., 1996; Nota et al., 2004; Murayama et al., 2013; Winn et al., 2019).

Metacognition refers to diverse aspects such as knowledge about cognition, awareness of one's thinking processes, comprehension of the requirements for learning, control of learning processes, and regulation of cognitive processes (Leutwyler, 2009). Metacognitive regulation is defined as "self-management" of cognition that supports awareness and includes reflective "self-evaluation" termed executive control (Tarricone, 2011). It entails planning, monitoring, and evaluation. (Mitsea & Drigas, 2019) Metacognitive strategies refer to monitoring, sequential processes to control learning, high-level executive skills, and decisions made before, during, and after learning. There is evidence that metacognitive strategies support cognitive abilities and meaningful learning (Cook et al., 2013), increase academic achievement (Cera et al., 2013), and boost self-efficacy (Hayat & Shateri, 2019).

Resource management strategies relate to the quality and quantity of engagement in a task and include time management, study environment management, effort management, and support from others (McKeachie et al., 1986). Resource management strategies, also known as non-cognitive strategies, include effort regulation (i.e., continuing to study despite boring, challenging, or uninteresting material), managing both time and place for study, asking for help from teachers or peers, and cooperating with other students or friends (Duncan & McKeachie, 2005). According to Filcher and Miller (2000), resource management strategies include learning schedules, high-quality work, incentives, and instructor interaction. Resource management sets clear objectives and plans the curriculum or content to produce the best results (McKeachie et al., 1986). For adult learners taking distance education courses, resource management strategies are an efficient method of improving success (Filcher & Miller, 2000).

2.2. Learning Strategies in Distance Education

Distance education in higher education institutions has gained prominence and importance with the advent of new technologies. Achieving success and quality in distance education services has become the focus of both educators and researchers (Bilgiç & Tüzün, 2020). While online learning opens up significant opportunities for developed and developing nations, particularly in tertiary education, setbacks can arise when traditional teaching methods are applied (Dahanarajan, 2001). As such, it's imperative to design quality learning strategies to enhance student motivation and success (Burns, 2011). Furthermore, online learning presents unique challenges, especially considering the reduced interaction, continuity, and support compared to traditional classroom settings (Dabbagh & Kitsantas, 2004). This makes the mastery of self-regulation skills especially vital for online students. Given that students often struggle with self-paced learning in virtual environments, the role of effective learning strategies becomes paramount (Bol & Garner, 2011).

In distance education, where the COVID-19 pandemic and the urgent shift to online learning have become necessary at all levels of education, academic success requires strategies different from those used in face-to-face learning settings (Shnaubert & Herold, 2020). In this situation, it has become essential to rethink how students are helped with their studies (Edisherashvili et al, 2022). Self-regulated learning (SRL) is important for face-to-face and distance education (Breslow et al., 2013). Distance education makes the value of SRL clearer. Aspirations,

motivation, and feelings are complex to support in distance learning, so different changes and careful instructional design planning are needed (Shnaubert & Herold, 2020). (Edisherashvili et al., 2022) Because of this, SRL skills and learning strategies are important in distance learning settings. Self-regulated learning is important for online education (Azevedo, 2009; Zimmerman, 2002). Its cognitive, metacognitive, and motivational aspects (Azevedo et al., 2010; Zimmerman, 2008) provide a strong theoretical framework for educational research. Zimmerman (2013) says that self-efficacy is very important. (Zimmerman, 2013) Learners with high self-efficacy are more likely to use SRL methods to reach their goals, while learners with low self-efficacy need external factors to control their learning. Bannert and Reimann (2012) say that it's important to understand individual differences in learner characteristics like course goals, educational level, self-efficacy, and gender, as well as behavior data that shows how learning strategies are related to different variables.

Academic achievement in distance education demands strategies distinct from face-to-face learning contexts, where the COVID-19 pandemic and the urgent transition to online learning have become necessary at all levels of education (Shnaubert & Herold, 2020). In this context, it is critical to evaluate the strategies utilized to assist students in their learning processes (Edisherashvili et al., 2022). Although self-regulated learning (SRL) applies to face-to-face types of learning, the distance education process emphasizes the relevance of SRL (Breslow et al., 2013). Different adjustments and instructional design preparation are required to support enthusiasm, motivation, and emotions, which are difficult to sustain in distance education (Shnaubert & Herold, 2020). As a result, in distance learning environments, SRL skills and related learning techniques are critical (Edisherashvili et al., 2022). Given the significance of self-regulated learning for online education (Azevedo, 2009; Zimmerman, 2002), its cognitive, metacognitive, and motivational characteristics provide a strong theoretical foundation for educational research (Azevedo et al., 2010; Zimmerman, 2008). Zimmerman (2013) stresses the significance of self-efficacy. Learners with strong self-efficacy are more likely to use SRL techniques to reach their goals, whereas those with low self-efficacy require external forces to manage their learning (Zimmerman, 2013). Bannert and Reimann (2012) emphasize the significance of understanding individual differences in commonly observed learner characteristics such as course intentions, educational level, self-efficacy, and gender, as well as behavioral data demonstrating the relationship of learning strategies with various variables.

Zhou and Wang (2021) aimed to test the Chinese version of the Motivational Strategies for Learning Scale Part-B for distance education (MSLQ-B-DE). The results show that the MSLQ-B-DL is a valid and reliable tool for assessing learning strategies in adult distance education in China. Research shows a positive relationship between self-regulated learning strategies and academic performance in a distance education environment (Broadbent, 2017; Lin et al., 2017; Shih & Gamon, 2001). SRL strategies have been found to improve online learners' digital literacy in the context of lifelong learning (Anthonysamy et al., 2020). Orhan (2007), in the research in a blended learning environment, found that the use of strategic self-regulated learning through the systematic application of self-observation, self-evaluation, and adaptation skills regarding learners' activities significantly improved learners' performance and self-efficacy perceptions when metacognitive strategies and resource management strategies were used. Karaoğlan Yılmaz et al. (2018) showed the positive effect of motivational strategy use through pedagogical agents on students' self-regulation skills in different contexts. Jin et al. (2023) showed that artificial intelligence applications in online learning environments are useful in supporting metacognitive, cognitive, and behavioral regulation in different SRL domains. Neroni et al. (2019) investigated the relationship between learning strategies and academic performance in distance education students. The participants comprised 758 students at a distance education university in the Netherlands. An online questionnaire was used to identify learning strategies, and exam grades were taken from the university database to determine academic performance. The mixed method study found that time and effort management and complex cognitive strategy use were positive predictors of academic performance. In contrast, communication with others was a negative predictor of academic performance.

3. Method

3.1. Research Design

In this study, the survey method, one of the quantitative research methods, was used. The survey method provides a quantitative description of the tendencies, attitudes, and opinions in the general population through studies conducted on a sample selected from a population (Creswell, 2013). According to Karasar (2015), the survey method is a study that aims to reveal an existing situation as it is. This study aims to examine the learning strategies used by

university students in terms of various variables in distance education. This study used a survey method to fully reveal the learning strategies that students use for distance education.

3.2. Participants and Implementation

The participants consisted of undergraduate students at a state university in Turkey. Students enrolled in the Atatürk's Principles and History of Revolution course conducted through distance education in the 2019-2020 academic year were included in the study. A total of 909 students participated in the data collection period. The data of 300 students were factor analyzed. The data of 609 participants were also used for analysis. At the end of the Spring 2020 semester, the personal information form and the MSLQ-B DE scale were presented to all students online via Google Forms.

3.3. Data Collection Tools

The study used personal information form including demographic and other information of the students, and the MSQL-B DE scale as data collection tools.

Personal Information Form

A personal information form developed by the researchers was used to determine the demographic and personal information of the students, such as gender, department, home internet usage, distance education preferences, factors they consider important in the distance education process, participation in extracurricular activities, and weekly study time.

Motivated Strategies for Learning Questionnaire Part B Distance Education (MSLQ-B DE) Scale

The MSLQ-B (DE) scale adapted by Meijs et al. (2019) for distance education students was used in the study to determine students' distance education learning strategies. The scale is divided into five subscales that determine the utilization of learning strategies. The scale, which was originally prepared as MSLQ-A (for motivation) and MSLQ-B (for learning strategies), was revised as MSLQ-B DE when it was used for the analysis of learning strategies in distance education processes and new subscales specific to distance education were identified. MSLQ-B DE was chosen for this study since the process was totally conducted via distance education. The scale is constructed as a 7-point Likert-type scale and consists of 25 items. A higher score in the data collected for each subscale (learning strategy) indicates that the stated learning

approach is being used more effectively. In this study, the average scores of the subscales were utilized to establish which learning strategies are used in distance education.

The MSLQ-B (DE) scale has five sub-dimensions, as was earlier mentioned. These include the usage of simple cognitive strategies, complex cognitive strategies, academic thinking, communication with others, and time, resource, and effort management. The original scale has 25 items on a 7-point Likert scale as responses. The application followed this specification. Translations were generated by two separate experts, and they were approved by a third expert, according to Sousa and Rojjanasrirat (2011). At these stages, any changes in meaning brought on by cultural adaptation were also taken into account (Sperber, 2004). With a group of 300 students, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were used to identify and validate the factor structure. According to Worthington and Whittaker (2006), EFA and CFA should be employed in scale development and adaptation research. Although it is common for adaptation studies to solely utilize confirmatory factor analysis, EFA and CFA were used in this study since it may result in issues like erroneous model fit in situations like translation difficulties (Orçan, 2018).

During the Exploratory Factor Analysis, since the factors were believed to be interrelated, the oblique rotation method (Corner, 2009) was utilized, and a 5-factor structure was obtained based on the compiled version of the scale. Following this analysis, it was determined to remove from the first factor the statement "when the lesson is difficult to study, I either give up or study only the easy parts" because it generated loading values that were comparable across factors. The EFA was repeated once this item is removed, and it was found that there was no any other item with similar load value in different factors. Therefore, the reliability values were examined by assuming that the scale was finalized. Table 1 shows the ultimate factors and Cronbach's alpha coefficients.

Table 1.

Factors and Cronbach's alpha coefficients

No	Item	Factor	Cr.a
1	7, 8, 9, 10, 11	Complex cognitive strategy use	.838
2	17, 18, 19, 20	Communication with others	.786
3	1, 3, 4, 5, 6	Time, resource, and effort management	.824
4	12, 13, 14, 15, 16	Simple cognitive strategy use	.854
5	21, 22, 23, 24, 25	Academic thinking	.868
Cronbach's Alpha (Composit Scale Reliability) = .921			

According to the oblique rotation method, factor loadings after rotation, average variance extracted (AVE), and other factor analysis results are given in Table 2.

Table 2.

Factor Loadings

Item	**Factor loadings**				
	CCSU	**CWO**	**TREM**	**SCSU**	**AT**
AVE	37.8%	8.5%	5.4%	4.1%	2.5%
10	.826				
9	.682				
8	.595				
11	.515				
7	.495				
17		.855			
18		.839			
20		.575			
19		.475			
4			.871		
3			.779		
1			.434		
5			.431		
6			.411		
16				.772	
15				.757	
14				.639	
13				.497	
12				.414	
22					.879
23					.808
24					.777
25					.686
21					.407
AVE Total: 58.3%			**KMO** = .923		
App. Chi-square = 4117			**df** = 276	**sig.** = .000	

The parameters obtained from the Confirmatory Factor Analysis also showed that the model fit well (X2/df=1.85, CFI=0.95, NFI=0.90, GFI=0.89, and RMSEA=0.05). Since the study used participants' self-report data, a single-factor test was applied to examine possible standard method bias. After exploratory factor analysis, the total variance explained by a single factor was 36.7%, less than 50%. This indicates that there is no significant common method bias in the data. The final 24-item questionnaire instrument was analyzed.

3.4. Data Analysis

It was determined that the data met the normality distribution with the QQ graph. The significance level for all analyses was set as $\alpha < .05$ (Field, 2013). T-test and analysis of variance

test (ANOVA) were applied to determine whether the groups' scores from the tests showed significant differences.

4. Result

4.1. Distribution of Participants by Gender

Considering the demographic data of 609 participants, 356 female (58.5%) and 253 male (41.5%) participants were analyzed.

Table 3.

Distribution of Participants by Gender

Gender	n	%
Female	356	58,5
Male	253	41,5
Total	609	100

4.2. Distribution of Participants by Faculty

Since there was a participant group across the whole university, students were asked to indicate the faculties they studied in. Analyzing the use of learning strategies, since 14 faculties would make analysis burden, faculties were grouped under 5 main headings based on the field and taking into account the number of students. These main fields and their explanations are given in the analysis title. Table 4 shows the distribution of participants according to 14 faculties.

Table 4.

Distribution of Participants by Faculty

Faculty	**n**	**%**	**Faculty**	**n**	**%**
Education	118	19,4	Theology	29	4,8
Arts and Science	105	17,2	Tourism	23	3,8
Communication	93	15,3	Veterinarian	16	2,6
Health Sciences	52	8,5	Civil Aviation	16	2,6
Sports Sciences	46	7,6	Forestry	14	2,3
Economics and Administrative Sciences	44	7,2	Fine Arts and Design	12	2,0
Engineering and Architecture	38	6,2	Medicine	3	0,5

4.3. Participation in Extracurricular Activities

Table 5 shows that students mostly do not participate in extracurricular activities in the distance education process (70.4%).

Table 5.

Participation in Extracurricular Activities

Yes / No	n	%
Yes	180	29,6
No	429	70,4
Total	609	100

4.4. Key Factors in Distance Education

Participants indicated Live courses as the most critical factor in distance education (n=402). Course materials (n=365), interaction (n=282), and feedback (n=188) were chosen as the most essential factors, respectively (Table 6).

Table 6.

Key Factors in Distance Education

Key Factors	**n**
Live Course	402
Material (video, document, presentation, etc.)	365
Interaction	282
Feedback	188
Usefulness of the LMS	166
Guidance	155
Measurement and Assessment	128
Other	9

4.5. Participants' Course Follow-up Environments

Table 7 shows that students follow the courses mostly on their smartphones (n=374). Three hundred nineteen students said they followed the courses on their personal computers, and 175 students followed the courses on shared devices. With the widespread use of smartphones, it is seen that the highest majority is on smartphones, followed by personal computers.

Table 7.

Course Follow-up Environments

Course Follow-up Environments	**n**
Smartphone	374
Personal computer	319
Shared device (computer, tablet, etc., shared at home)	175
Tablet PC	28
Outside the home (internet cafe, neighbor, etc.)	24
Other	2

4.6. Participants' Teaching Method Preference

Table 8 shows that most students preferred face-to-face education (64.9%, n=395) or hybrid (22.7%, n=138). Students who only wanted distance education were in the minority (8.5%). Twenty-four participants stated that there was no difference (3,9%).

Table 8.

Participants' Teaching Method (Face-to-Face, Distance, Blended) Preference

Teaching Method	n	%
Face-to-face	395	64,9
Hybrid	138	22,7
Distance	52	8,5
Equal (No difference)	24	3,9
Total	609	100

4.7. Participants' Weekly Study Hours

In terms of weekly study hours, it is observed that participants typically spend between 30 minutes and 1 hour. One hundred seventy-eight participants said they allocated 1-2 hours of study time, while 117 said they gave less than 30 minutes. Sixty-seven participants indicated that they spent more than 2 hours. Students typically reported weekly study times of 30 minutes to one hour and 1-2 hours (Table 9).

Table 9.

Participants' Weekly Study Hours

Study Hours	n	%
30 minutes-1 hour	247	40,6
1-2 hours	178	29,2
Less than 30 minutes	117	19,2
More than 2 hours	67	11,0
Total	609	100

4.8. Findings on the Use of Learning Strategies in Distance Education

Analyzing the use of learning strategies in distance education, the scale items were subjected to descriptive analysis according to the factors. The ranking of learning strategies according to their mean scores is given in Table 10.

Table 10.

Use of Learning Strategies in Distance Education

Learning Strategy	Mean	sd
Complex cognitive strategy use	4.97	1.24
Simple cognitive strategy use	4.81	1.33
Academic thinking	4.79	1.30
Time, resource, and effort management	4.30	1.16
Communication with others	3.82	1.50

According to the means, complex cognitive strategy use has the highest mean. Simple cognitive strategy use, academic thinking, and time, resource, and effort management are the strategies used, respectively. The strategy of communication with others was determined to be the least used strategy compared to the others (Table 10).

4.9. Changes in the Use of Learning Strategies in Distance Education by Gender

Table 11 shows the results of the t-test analyses conducted to determine whether there is a gender difference in using learning strategies.

Table 11.

Changes in the Use of Learning Strategies in Distance Education by Gender

	Gender	N	X	sd	df	t	P
Complex cognitive strategy use	Male	258	4.85	1.21	1	-2.083	.038
	Female	351	5.06	1.25			
Communication with others	Male	258	3.92	1.46	1	1.458	.145
	Female	351	3.74	1.52			
Time, resource, and effort management	Male	258	4.30	1.20	1	-.152	.879
	Female	351	4.31	1.12			
Simple cognitive strategy use	Male	258	4.60	1.30	1	-3.423	.001
	Female	351	4.97	1.33			
Academic thinking	Male	258	4.79	1.25	1	.049	.961
	Female	351	4.79	1.33			

The table shows that there is a significant difference in the use of complex cognitive strategy ($t=-2.083$, $p<.05$) and simple cognitive strategy ($t=-3.423$, $p<.05$) in terms of gender. It was determined that women were at a higher level than men in both simple and complex cognitive strategy use in distance education.

4.10. Changes in the Use of Learning Strategies in Distance Education by Department

To begin with, the researchers organized the faculties and colleges where the students attend according to the scientific disciplines, keeping in mind that the number of students in each field

was equal to improve the analysis. These units are all made up of undergraduate programs that last at least four years. The grouping was determined as follows:

- One hundred eighteen students are comprised of trainees in the teaching profession from the Faculty of Education.
- Students from the faculties of medicine, veterinary medicine, health sciences, and sports sciences comprise the 117 students health-sports group.
- Students from the faculties of science, engineering and architecture, forestry, and civil aviation school make up the science-technology group (133 students).
- Students from the Fine Arts and Design and Communication faculties make up the 105 students Design-Communication group.
- Students from the faculties of literature, economics and administrative sciences, theology, and tourism make up the social sciences group (136 students).

Table 12 contains the findings of the one-way analysis of variance (ANOVA) carried out to see whether there are variations in the students' learning strategies based on their faculty or field of study.

Table 12.

Changes in the Use of Learning Strategies in Distance Education by Department

	Department	N	X	sd	VS	SS	df	MS	F	P
Complex cognitive strategy use	Education	118	5.15	1.19	B. groups	13.616	4	3.404	2.232	.064
	Health-Sport	117	4.77	1.23	W. groups	921.188	604	1.525		
	Science-Tech.	133	4.90	1.14	Total	934.804	608			
	Design-Com.	105	4.87	1.36						
	Social Sci.	136	5.13	1.24						
Communication with others	Education	118	3.74	1.51	B. groups	9.717	4	2.429	1.084	.363
	Health-Sport	117	3.71	1.56	W. groups	1353.039	604	2.240		
	Science-Tech.	133	3.83	1.55	Total	1362.756	608			
	Design-Com.	105	4.08	1.36						
	Social Sci.	136	3.77	1.48						
Time, resource, and effort management	Education	118	4.25	1.05	B. groups	9.652	4	2.413	1.818	.124
	Health-Sport	117	4.11	1.08	W. groups	801.707	604	1.327		
	Science-Tech.	133	4.33	1.17	Total	811.358	608			
	Design-Com.	105	4.30	1.25						
	Social Sci.	136	4.49	1.20						
Simple cognitive strategy use	Education	118	5.06	1.25	B. groups	17.355	4	4.339	2.478	.043
	Health-Sport	117	4.58	1.24	W. groups	1057.742	604	1.751		
	Science-Tech.	133	4.71	1.33	Total	1075.097	608			
	Design-Com.	105	4.75	1.40						
	Social Sci.	136	4.93	1.39						
Academic thinking	Education	118	4.87	1.37	B. groups	3.835	4	.959	.566	.687
	Health-Sport	117	4.72	1.26	W. groups	1023.313	604	1.694		
	Science-Tech.	133	4.72	1.21	Total	1027.149	608			
	Design-Com.	105	4.73	1.40						
	Social Sci.	136	4.89	1.29						

The table shows a difference only in the use of simple cognitive strategies ($F=2.478$, $p<.05$). The use of simple cognitive strategies by the Faculty of Education students was higher than those studying in other fields. Using simple cognitive strategies, students in Education are followed

by those in Social, Design-Communication, and Science-Technology. Students in the area of Health-Sports have the lowest mean in the use of this strategy.

4.11. Changes in the Use of Learning Strategies in Distance Education by Teaching Method Preferences

Students were asked which of the four types of instruction they found most effective. Some students found distance or face-to-face education useful, students found both equally useful, and students found hybrid education useful. Table 13 shows the results of the one-way analysis of variance (ANOVA) conducted to determine if there is a difference in the use of learning strategies based on the teaching method that students find most effective (face-to-face, distance, hybrid, equal).

Table 13.

Changes in the Use of Learning Strategies in Distance Education by Teaching Method Preferences

	Teaching Method	**N**	**X**	**sd**	**VS**	**SS**	**df**	**MS**	**F**	**P**
Complex cognitive strategy use	Face to face	395	4.90	1.29	B. groups	8.388	3	2.796	1.826	.141
	Distance	52	5.15	1.41	W. groups	926.416	605	1.531		
	Hybrid	138	5.04	1.01	Total	934.804	608			
	Equal	24	5.37	1.08						
Communication with others	Face to face	395	3.77	1.48	B. groups	20.102	3	6.701	3.019	.029
	Distance	52	4.41	1.60	W. groups	1342.655	605	2.219		
	Hybrid	138	3.75	1.45	Total	1362.756	608			
	Equal	24	3.77	1.62						
Time, resource, and effort management	Face to face	395	4.21	1.17	B. groups	19.997	3	6.666	5.096	.002
	Distance	52	4.81	1.29	W. groups	791.361	605	1.308		
	Hybrid	138	4.34	.95	Total	811.358	608			
	Equal	24	4.65	1.33						
Simple cognitive strategy use	Face to face	395	4.70	1.38	B. groups	16.204	3	5.401	3.086	.027
	Distance	52	5.08	1.42	W. groups	1058.893	605	1.750		
	Hybrid	138	4.94	1.06	Total	1075.097	608			
	Equal	24	5.28	1.44						
Academic thinking	Face to face	395	4.74	1.32	B. groups	8.535	3	2.845	1.690	.168
	Distance	52	5.02	1.33	W. groups	1018.613	605	1.684		
	Hybrid	138	4.77	1.23	Total	1027.149	608			
	Equal	24	5.23	1.23						

Table shows that there is a significant difference in the use of simple cognitive strategies ($F=3.086$, $p<.05$), communication with others ($F=3.019$, $p<.05$), and time, resource and effort

management (F=5.096, p<.05) factors in the use of learning strategies according to which type of education students find useful. It was observed that students who preferred distance education had higher levels of communication with others and time, resource, and effort management than students who chose face-to-face education, students who preferred hybrid education, and students who considered both equally valuable. In the use of simple cognitive strategies, students who think both types of teaching equally differed significantly from the others.

4.12. Changes in the Use of Learning Strategies in Distance Education by Participation in Extracurricular Activities

Table 14 shows the results of the t-test analyses to determine whether there is a difference in the use of learning strategies between distance education students who participate in extracurricular activities and those who do not.

Table 14.

Changes in the Use of Learning Strategies in Distance Education by Participation in Extracurricular Activities

	Extracurricular Activities	N	X	sd	t	p
Complex cognitive strategy use	Yes	180	5.17	1.17	2.550	.011
	No	429	4.89	1.26		
Communication with others	Yes	180	4.10	1.55	3.046	.002
	No	429	3.70	1.46		
Time, resource, and effort management	Yes	180	4.57	1.18	3.697	.000
	No	429	4.19	1.13		
Simple cognitive strategy use	Yes	180	5.06	1.27	3.023	.003
	No	429	4.70	1.34		
Academic thinking	Yes	180	5.04	1.22	3.072	.002
	No	429	4.67	1.31		

The table shows a difference in the use of all learning strategies regarding participation in extracurricular activities (Complex cognitive strategy use: t=2.550, p<.05; Communication with others: t=3.046, p<.05; Time, resource, and effort management: t=3.697, p<.05; Simple cognitive strategy use: t=3.023, p<.05; Academic thinking: t=3.072, p<.05). It was determined that the students who participated in extracurricular activities were significantly higher in all dimensions in the use of learning strategies than those who did not participate.

4.13. Changes in the Use of Learning Strategies in Distance Education by Weekly Study Hours

Table 15 shows the results of a one-way analysis of variance (ANOVA) to see if there is a difference in students' use of learning strategies based on their weekly study hours.

Table 15.

Use of Learning Strategies in Distance Education by Weekly Study Hours

	Weekly Study Hours	**N**	**X**	**sd**	**VS**	**SS**	**MS**	**F**	**P**
Complex cognitive strategy use	<30 min.	117	4.45	1.36	B. groups	53.539	17.846	12.233	.000
	30 min-1 hours	247	4.93	1.20	W. groups	881.128	1.459		
	1-2 hours	178	5.27	1.07	Total	934.667			
	> 2 hours	66	5.23	1.24					
Communication with others	<30 min.	117	3.30	1.54	B. groups	56.685	18.895	8.740	.000
	30 min-1 hours	247	3.80	1.36	W. groups	1305.747	2.162		
	1-2 hours	178	3.97	1.54	Total	1362.432			
	> 2 hours	66	4.39	1.53					
Time, resource, and effort management	<30 min.	117	3.60	1.17	B. groups	108.822	36.274	31.187	.000
	30 min-1 hours	247	4.19	1.09	W. groups	702.527	1.163		
	1-2 hours	178	4.75	.99	Total	811.349			
	> 2 hours	66	4.74	1.09					
Simple cognitive strategy use	<30 min.	117	4.01	1.44	B. groups	127.165	42.388	27.014	.000
	30 min-1 hours	247	4.74	1.28	W. groups	947.763	1.569		
	1-2 hours	178	5.22	1.09	Total	1074.928			
	> 2 hours	66	5.38	1.19					
Academic thinking	<30 min.	117	4.25	1.38	B. groups	57.859	19.286	12.020	.000
	30 min-1 hours	247	4.74	1.29	W. groups	969.122	1.605		
	1-2 hours	178	5.06	1.16	Total	1026.981			
	> 2 hours	66	5.20	1.26					

The table shows a significant difference in the use of all learning strategies (Complex cognitive strategy use: F=12.233, p.05; Communication with others: F=8.740, p<.05; Time, resource, and effort management: F=31.187, p<.05; Simple cognitive strategy use: F=27.014, p<.05; Academic thinking: F=12.020, p<.05). In complex cognitive strategy use and time, resource and effort management strategies, students who studied between 1-2 hours per week were significantly different from other students, while in simple cognitive strategy use, communication with

others and academic thinking strategies, students who studied more than 2 hours per week were at a higher level than other groups.

5. Discussion and Conclusion

When the student's demographic data is analyzed, it is discovered that the gender distribution is similar. The distribution of the department/field of study shows that there are participants from practically all of the university's four-year undergraduate fields. The great majority of students do not participate in extracurricular activities. This condition is consistent with research that found that when individual effort and responsibility increased in distance education, even if these tasks were met, not much time was dedicated to other activities (Aguilera-Hermida, 2020; Kara, 2022). Students answered that the most significant aspects of distance education are live lectures, course materials, and engagement. This information is consistent with earlier research (Afşar & Büyükdogan, 2020; Hotar et al., 2021; Karatepe et al., 2020). The courses are mostly studied on smartphones and personal computers, with internet access provided by ADSL or mobile data at home. When we look at the teaching method preferences of students, we can find that they favor face-to-face education the most. As indicated below, there are variances in the application of learning strategies in this sense.

The most prominent complex cognitive strategy in the use of learning strategies in the distance education process is the use of cognitive strategies. In online learning environments, students try to gain academic skills in attempting to gain self-regulation skills. This returns to the student as more responsibility than in face-to-face environments (Wandler & Imbriale, 2017; Zimmerman, 2002). Although there are even instant interaction opportunities in distance education environments, the fact that they are not used as in face-to-face settings, or their use remains limited, requires more responsibility and self-discipline for effective learning (Aslan, 2006). For this reason, the learner's efforts are also important in using learning strategies (Küçük, 2010). For example, a study on the use of motivational strategies in distance education with high school students determined that distance education increased students' responsibilities and forced them to use cognitive strategies (Gür, 2022). In parallel with the literature, it is thought that the higher level of complex cognitive strategy use than other strategies is related to the fact that distance education imposes more responsibility on students than face-to-face education.

Although there is no difference in the use of other learning strategies, it is seen that female students are at a higher level than male students in the use of simple and complex cognitive strategies. In distance education programs, female students are at a higher level of self-regulation and cognitive strategy use than male students (Gür, 2022), and female students use learning strategies at a higher level than male students (Başarıcı, 2012). Similarly, in field-based approaches, female students were found to be at higher levels than male students in grammar learning strategies (Zarrinabadi et al., 2021), mathematics learning strategies (Degol et al., 2018) and self-efficacy studies (Diseth et al., 2014). In parallel with these studies in the literature, it is seen that female students have a higher level of cognitive strategy use in distance education than male students.

It was seen that students differed only in the use of simple cognitive strategy according to the faculty/field they studied. Faculty of Education students were found to be at a significantly higher level than the others in using this learning strategy. There is no precise study in the literature to distinguish the students of the Faculty of Education from the students of other fields in the use of these strategies. However, this may indicate that students directly involved in the curriculum, which has comprehensive content on learning and teaching, such as Teaching Principles and Methods, Teaching Methods and Techniques, and Psychology of Learning, are better at using learning strategies than others. In a study examining the effect of teaching strategies on the use of learning strategies, it was stated that teaching strategies affect the number and type of learning strategies used by students (Karakoç & Şimşek, 2004). Therefore, it can be said that pre-service teacher students have higher means in the use of simple cognitive strategies.

Most of the participants (64.6%) stated that they preferred face-to-face education. The scores of the students who chose distance education (22%) on the sub-dimensions of "communication with others" and "time, resource, and effort management" strategies were significantly higher than the scores of other students. Due to the lack of social communication in the absence of a face-to-face education environment (Aydemir, 2021; Batur, 2022; İşman, 2011;), it is inevitable for those who prefer distance education to use communication strategies with others. Similarly, the high use of these strategies in distance education, independent of time and resources and dependent on responsibility and effort (İşman, 2011), is an expected result. Using simple cognitive strategies, the means of the students who saw both types of education at equal value

were higher than the others. While there is no research for this data, the fact that a student who does not particularly prefer face-to-face or distance education is higher in the use of simple cognitive strategies than those who prefer one type of instruction may be significant in terms of showing that strategy use does not depend on a preference.

It is seen that students who stated that they participated in extracurricular activities in the distance education process were at a higher level in the use of all learning strategies than those who did not. This shows that students who do not limit themselves to course activities are at an advanced level in strategy use as expected if responsibility is at the forefront in the distance education process. This result is in line with previous studies. It is seen that those who engage in different activities are at a better level in self-regulation and cognitive strategy use (Gür, 2022), and students who prioritize responsibility in different learning domain strategies are at a higher level (Degol et al., 2018).

Considering the weekly study hours, the students who work for 1-2 hours and more than 2 hours differ significantly from those who work for less time in the dimensions of using learning strategies. It has been observed that as the weekly study time increases, pre-service teachers' learning strategies also increase (Yıldızlar, 2012). This is in line with the study's results, showing that students who spend more time studying in distance education use learning strategies more.

This study aimed to develop the Turkish adaptation of the MSLQ-B DE and provide a valid and reliable assessment tool for assessing learning strategies in distance education. Furthermore, the utilization of learning strategies within a selected group in Turkey was assessed by implementing this scale. Measuring the utilization of learning strategies is crucial for the efficacy of online education. Thus, the adapted scale is considered an essential metric for academic research and professionals in distance education.

6. Recommendations

For further studies

- The use of learning strategies by various sample groups can be examined using this adapted scale.

- Conducting comparative studies between this scale and other scales to assess the use of learning strategies in online education could make a valuable contribution.
- Conducting studies that thoroughly examine the correlation between the use of learning strategies and variables such as meaningful learning, academic achievement, self-efficacy, and effort management might be beneficial.
- Qualitative data analysis on key factors acquired from a study can strengthen data variety.

For practitioners

- The level of communication with others needed to be improved. Therefore, it is necessary to prioritize collaborative strategies that facilitate learners' communication in distant education settings.
- Individuals who engaged in extracurricular activities exhibited elevated average scores across all sub-factors. This indicates that there is a need to enhance extracurricular activities in order to strengthen learning processes. Furthermore, augmenting extracurricular activities can be advantageous in reinforcing the sub-factor of communication with others.

7. Limitations

The selection of participants from a single university with a convenient sampling method is one of the limitations of this study. This study analyzed the scale adaption and data from a sample group. However, due to the word constraint, the analysis of key factors was limited to a descriptive level.

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Research Article

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Using Memory Places in Social Studies Teaching

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Abstract

The aim of this study is to enable pre-service teachers studying in the undergraduate program of social studies teaching to recognize memory places that can be accepted as out-of-school learning environments, to associate them with social studies education and to show them how to use memory places in their fields. Action research, one of the qualitative research models, was used in the study. "Interview Form 1" and "Interview Form 2" developed by the researcher were used as data collection tools. Before the implementation process started, the researcher applied Interview Form-1 to the final year pre-service social studies teachers. As a result of the examination of the applied form, 23 volunteer pre-service teachers who gave insufficient answers to the questions were determined as the study group. A total of 30 sessions and 57 hours of practice were conducted with the study group. At the end of each session, feedback about the application were received from the pre-service teachers. At the end of 30 sessions, "Interview Form 2" was applied to the study group and an evaluation was made about the whole process. The data obtained from the study group were analyzed using descriptive analysis and content analysis. When the results of the study are evaluated in general, it can be said that all of the pre-service social studies teachers in the study group were able to explain the memory places at the end of the applications. It is also possible to say that they were able to identify memory places in out-of-school learning environments, associate memory places with social studies course outcomes, and prepare lesson plans for out-of-school learning environments using memory places. In the light of the results of the research, memory places throughout Turkey can be identified and studies can be carried out on how they can be used in social studies. In addition, in-service training can be given regarding the implementation process of memory places.

Keywords: Social studies, Memory places, Out-of-school learning, Out-of-school learning environment, Learning candidate

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Hafıza Mekanlarının Sosyal Bilgiler Öğretiminde Kullanılması

Özet

Bu araştırmanın amacı, sosyal bilgiler öğretmenliği lisans programında öğrenim gören öğretmen adaylarının okul dışı öğrenme ortamlarından kabul edilebilecek hafıza mekânlarını tanımasını, sosyal bilgiler eğitimi ile ilişkilendirmesini sağlamak ve hafıza mekânlarını alanlarında nasıl kullanacaklarını onlara göstermektir. Araştırmada nitel araştırma modellerinden eylem araştırması kullanılmıştır. Araştırmada veri toplama aracı olarak, araştırmacı tarafından geliştirilen, "Görüşme Formu 1" ve "Görüşme Formu 2" kullanılmıştır. Uygulama süreci başlamadan önce araştırmacı, sosyal bilgiler öğretmenliği bölümü son sınıf öğretmen adaylarına Görüşme Formu 1'i uygulamıştır. Uygulanan formun incelenmesi sonucunda sorulara yetersiz cevap veren öğretmen adaylarından gönüllü 23 kişi çalışma grubu olarak belirlenmiştir. Çalışma grubu ile 30 oturum ve toplam 57 saat uygulama yapılmıştır. Her oturum sonunda öğretmen adaylarından uygulama ile ilgili dönütler alınmıştır. 30 oturum sonunda çalışma grubuna "Görüşme Formu 2" uygulanmış ve tüm süreçle ilgili değerlendirme yapılmıştır. Çalışma grubundan elde edilen veriler, betimsel analiz ve içerik analizinden yararlanılarak çözümlenmiştir. Araştırmanın sonuçları genel olarak değerlendirildiğinde, uygulamalar sonunda çalışma grubundaki sosyal bilgiler öğretmen adaylarının hepsinin hafıza mekânlarını açıklayabildiği söylenebilir. Ayrıca okul dışı öğrenme ortamları içerisinde hafıza mekânlarını belirleyebildiklerini, sosyal bilgiler dersi kazanımlarıyla hafıza mekânlarını ilişkilendirebildiklerini ve hafıza mekânlarını kullanarak okul dışı öğrenme ortamlarına yönelik ders planı hazırlayabildiklerini söylemek mümkündür. Araştırmanın sonuçları ışığında Türkiye genelinde yer alan hafıza mekanları tespit edilip bunların sosyal bilgilerde nasıl kullanılabileceğine yönelik çalışmalar yapılabilir. Ayrıca hafıza mekanlarının uygulama süreciyle ilgili hizmet içi eğitimler verilebilir.

Anahtar Kelimeler: Sosyal bilgiler, Hafıza mekanları, Okul dışı öğrenme, Okul dışı öğrenme ortamı, Öğrenme adayı

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1. Introduction

One of the key objectives of education is to motivate students in the classroom setting and ensure they are ready to learn. The manner in which lessons are delivered and the learning environments are significant factors in achieving this. Learning environments are crucial elements that contribute to student learning. Typically, the educational process is structured within schools and classrooms. However, schools and classrooms can sometimes be inadequate for effectively teaching certain subjects. Non-school places play an important role in supporting student motivation, making the lesson fun, breaking the monotony of the classroom, enhancing students' cognitive, affective, and psychomotor skills, and helping to achieve the lesson's objectives (Eshach, 2007; Akhan & Kaymak, 2019). From the perspective of social sciences, many places can serve as learning environments. For historians, a historical archive; for geographers, terrains; for archaeologists, a dig site; for lawyers, courthouses; and for sociologists, a neighborhood can be significant working places. In this vein, expecting a course, specifically social studies, which is informed by the social sciences, to achieve its objectives solely within the school and classroom setting would not be an appropriate approach (Akhan & Kaymak, 2019).

Orr (2004) defines out-of-school learning as education aimed at fostering a sense of good citizenship adapted to living in a place without altering its natural fabric. Considering that the fundamental goal of social studies is to cultivate good and effective citizens (NCSS, 2014), Orr's statement highlights the significance of out-of-school learning for social studies. Social studies, which possess a multidisciplinary nature and take on the task of regulating an individual's relationship with society (Parker, 2009; Sönmez, 2010), greatly benefit from out-of-school learning experiences in effectively achieving its objectives. These experiences can range from involving students in examining the history of their community to managing a recycling center, analyzing a consumer's preferences for a specific brand, studying inscriptions on gravestones, or visiting a nearby historical site (Knapp, 1986). Social studies education conducted outside of school can both broaden children's learning experiences and facilitate their acquisition of knowledge about science and the natural world. Students gain the opportunity to experience nature firsthand and learn environmental rules more effectively (Auer 2008). Therefore, planning social studies course contents, methodologies, and durations to be compatible with

out-of-school activities is of great importance (Çengelci, 2013; Şeyihoğlu & Uzunöz, 2012; Akengin & Ersoy, 2015; Coşkun Keskin & Kaplan, 2012).

Teachers are expected to identify an out-of-school learning environments location and select appropriate learning objectives to tailor their lesson plans accordingly during in-service training. Studies have shown that while teachers believe that lessons taught in out-of-school learning environments have an impact on the learning-teaching process, they tend not to prefer conducting lessons in these environments (Orion et al., 1997; Simmons, 1998; Carrier, 2009). Therefore, it is essential for social studies teachers to acquire the necessary skills to utilize out-of-school learning environments and incorporate them into their teaching, either before or during their service. There are many places outside of school that are conducive to effectively conveying social studies topics. These places also serve as memory places, reflecting the shared past, joys, and sorrows of communities. The concept of memory places was introduced by French historian Pierre Nora. In his work "Realms of Memory," Nora discusses how elements sustaining national memory and culture are found in these memory places. Before delving into memory places, it is appropriate to explain the relationship between memory and place.

Memory is involved in the formation of our existence and is a record of our way of understanding or perceiving the world (Vigne, 2019). Simply put, memory is the process of encoding and storing records of experiences that can be recalled or reemerged in subsequent applications. This process can occur voluntarily or involuntarily (Jones, 2011). Huyssen (1999) notes that what constitutes memory is a delicate fissure between the past and the present. This fissure keeps memory vividly alive, distinguishing it from archives or any other storage and system. There are certain places in society where people revisit and revitalize their past, rekindling their memories and attachments. Altman and Low (1992) argue that these attachments are not only to physical places but primarily to the meanings and experiences associated with the place. In essence, Altman and Low are setting the groundwork for Nora's concept of "memory places."

Pierre Nora (1994) elucidates the concept of memory places, stating, "I saw our national memory rapidly disappearing and embarked on a census of memory places; memory especially emerges within these places and the most striking symbols are seen here, dependent on people's will or the centuries: Festivals, emblems, monuments, commemorative ceremonies, as well as

panegyrics, dictionaries, and museums." Boyer (1994, pp. 26-31) also emphasizes that places are significant tools in retaining and reproducing the experiences embedded in societies' memories. Collective memory created by people is often associated with objects and places, with places revealing the collective memory of individuals. The social memory, consisting of memories and past experiences, is indeed a part of the place and binds its inhabitants to it (Rossi, 1982). Norberg-Schulz (1979) perceives place as a living organism, arguing that it possesses a character and that over time, as the network of social relations deepens, a genius locus, or spirit of the place, develops. Norberg-Schulz's concept of genius loci bears resemblance to Nora's memory places. As many scholars have pointed out, it is plausible to assert that memory is associated with places, and that society's culture, cultural heritage, identity, and affiliations are revitalized and evolve through places.

The concept of place essentially links the mental with the cultural, and the social with the historical. Social relations and concrete abstractions find real existence only within and through place. Their foundations are spatial (Lefebvre, 2014, pp. 25,402). Assmann (2015, p. 23) articulates that memory places shape and sustain significant experiences and memories over time, adding images and stories of another time to the horizon of the present and reviving memories, thus merging the past with the present. These places, which unite people in a "we," create a binding structure based on both adherence to social norms and values and the memories of a collective memory. Proceeding from this, the integration of social studies curriculum, which aims to cultivate citizens respectful of their past, history, and cultural heritage, with out-of-school learning environments will facilitate the real-life manifestation of these subjects. This is because social studies is the most appropriate subject to deliver heritage education. Social studies encompass the practices, values, rituals, traditions, and customs in which a person lives and participates (Karakuş, 2017). Owing to its capacity to contain both abstract and concrete topics like cultural heritage, social studies possess a rich content in terms of memory places. Therefore, the use of memory places, which are out-of-school learning environments, in teaching cultural heritage topics will enable students to gain concrete experiences, thereby accelerating their progress towards educational objectives. The use of memory places in social studies classes, which are a cultural treasure trove waiting to be explored within out-of-school learning environments, is thought to not only effectively convey learning outcomes but also to strengthen students' sense of belonging to the past and, in turn,

support the conservation of national memory. This research aims to serve as a model for teacher candidates to discover and utilize memory places within out-of-school learning environments in their teaching, thereby contributing to the field.

A review of the literature related to the topic reveals no direct studies on the use of memory places as an out-of-school learning environments in social studies. However, the existence of some studies has been identified regarding the use of memory places in teaching (Karatekin et al., 2017; Çapkın, 2018), in action research (Öztaşçı, 2017; Hayta & Akhan, 2014; Akça Berk, 2012), in utilizing historical places in social studies (Üztemur et al., 2018a; Üztemur, Dinç & Acun, 2018b), and in creative drama with action research (Bayram & Çalışkan, 2019; Aysal, 2012). Additionally, it is observed that research on memory places is generally concentrated in the fields of sociology and architecture (Ak, 2018; Aktin, 2017; Aydoğan, 2016; Biçel, 2013; Biricik, 2016; Bilginer Erdoğan, 2013; Cihangiroğlu, 2016; Cihangiroğlu, 2019; Doğu & Varkal Deligöz, 2017; Dural Tasouji, 2013; Ekman, 2009; Karakaş, 2019; Kır, 2016; Kırcı, 2015; Mowla, 2004; Öymen Özak & Pulat Gökmen, 2009; Parmaksız, 2012; Pösteki, 2012; Saç, 2009; Sarıkaya Levent, 2017; Suda, 2017; Tekin, 2017; Uzunoğlu, 2018; Yıldırım, 2018; Yüksel, 2019).

2. Method

2.1. Research Model

In this study, the aim was to enhance the knowledge of senior pre-service social studies teachers about both out-of-school learning environments and memory places that contribute to cultural continuity, and to enable them to relate and utilize memory places in their teaching. To this end, action research, one of the qualitative research methods, was used. Action research is a research model that involves practicing, collecting data, and analyzing to understand and solve an existing problem, conducted by a practitioner working in any institution alone or with the help of a researcher (Yıldırım & Şimşek, 2013). Aksoy (2003) discusses some prominent features of action research, including the primary goal of improving practice, direct involvement of the practitioner in the research process, and conducting the research with real people in real settings. In this study, activities were conducted in real settings, namely the education faculty and various out-of-school learning environments, with real students, aiming to increase the knowledge levels of pre-service teachers with the researcher's involvement in the process.

2.2. Study Group

The study group of the research consisted of 23 pre-service teachers, 13 female and 10 male, from the Department of Social Studies Education in a faculty of education located in the Mediterranean region, all of whom were in their final year. To determine the study group, initially, a Group Interview Form 1 was administered to 76 senior pre-service teachers. This tool aimed to gather pre-service teachers' views on out-of-school learning environments and memory places and also requested them to create a lesson plan relating social studies lessons to memory places. It was determined that the pre-service teachers lacked knowledge about memory places, and none could adequately complete the lesson plan related to the out-of-school learning environments as required by the form. These pre-service teachers were informed about the purpose of the study and those who could allocate the necessary time and maintain continuous participation signed a consent form to volunteer for the study. It is possible to say that the study group was determined through criterion sampling and convenience sampling.

Criterion sampling aims to work with individuals who meet predefined conditions. The fundamental notion in criterion sampling is to study all cases that meet a predetermined set of criteria. These criteria can be developed by the researcher or may use an existing list of criteria (Yıldırım & Şimşek, 2013). In this study, the criteria sought were being senior social studies pre-service teachers, having the competency to prepare lesson plans due to internship experiences, and lacking the competency to relate social studies lessons with out-of-school learning and memory places. The convenience sample used in determining the study group was chosen due to its "accessibility, ease of access, and adding speed and practicality to the research" (Yıldırım & Şimşek, 2013).

2.3. Data Collection

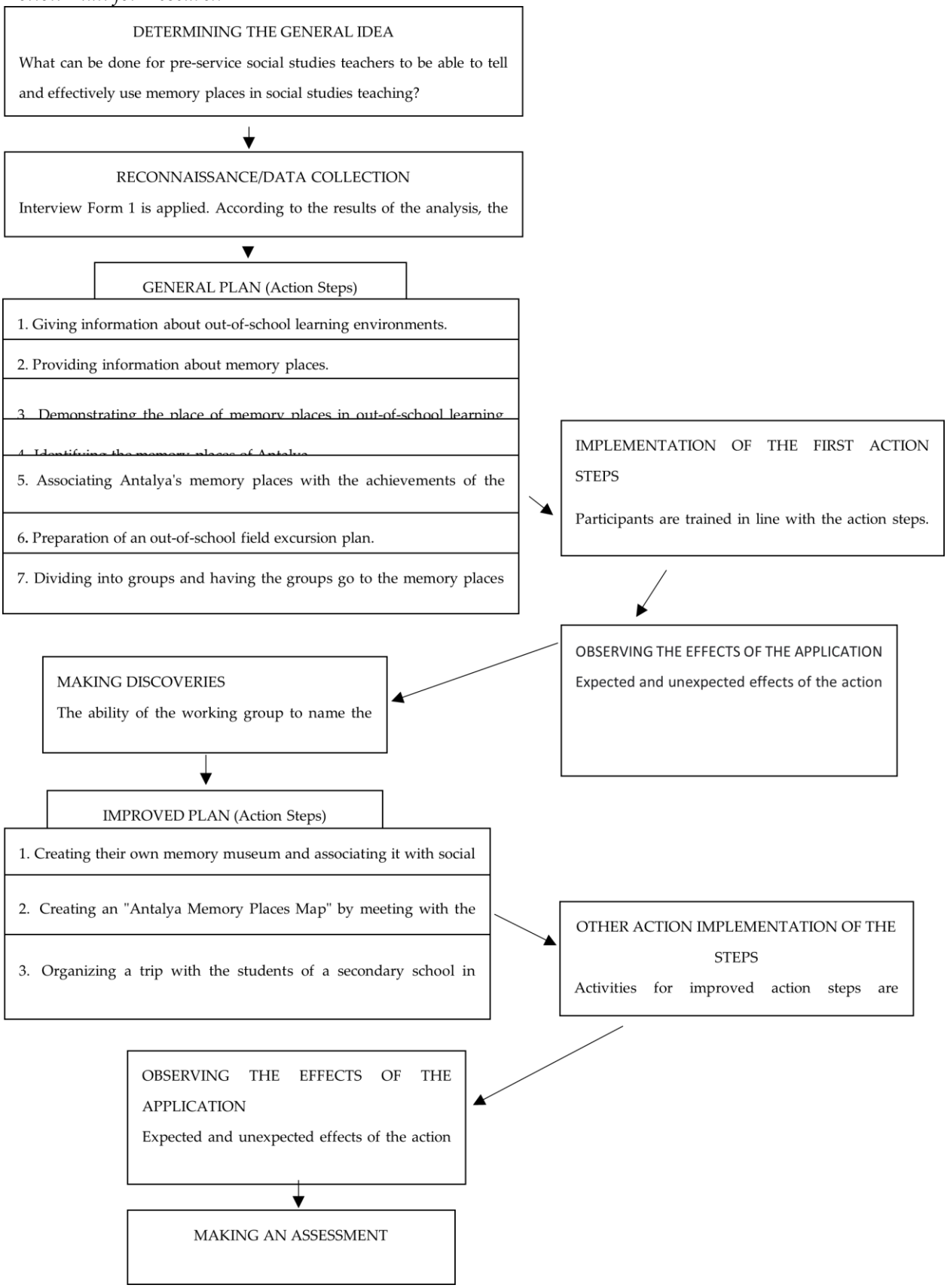
The data for the research were collected using Interview Form 1, Interview Form 2, and the Session Evaluation Form administered at the end of each session, all prepared by the researchers. In addition, on the final day of the applications, the lesson plans prepared by the study group were used for data collection. The data collection tools were reviewed by two field experts. Following their feedback, the tools were presented to a language expert for review and

linguistic control. Subsequently, the final versions of the data collection tools were established, and the necessary permissions were acquired.

Before commencing the applications and data collection process in the research, the researchers prepared an action plan due to the action research nature of the study. The action plan constitutes the first stage of the five-stage cyclical structure of action research (Kemmis, McTaggart, and Retallick, 2000, cited in Keser Özmantar, 2019). In preparing the action plan, the researchers utilized Aksoy's (2003) Stages of Action Research Diagram to develop the cycle for their research.

Figure 1.

Action Plan for Research



Application Process

Before commencing the application process, the researchers administered Interview Form 1 to the senior pre-service social studies teachers. Interview Form 1 consists of questions aimed at revealing the readiness of pre-service teachers regarding out-of-school learning, memory places, and their integration with social studies. Following the examination of the completed forms, 23 pre-service teachers who were unable to answer the questions and volunteered to participate in the study were determined as the study group.

Table 1.

Sessions in the Implementation Process

	SESSION	DURATION	PURPOSE
Session 1	Creating Group Dynamics -I	120′	To enable the working group to meet each other and adapt to the process.
Session 2	Creating Group Dynamics -II	120′	To increase the interaction of the working group with each other and to ensure harmony and trust.
Session 3	Out-of-School Learning Environments	120′	To examine the readiness of the working group about out-of-school learning environments and to complete their deficiencies on the subject.
Session 4	Our Cultural Heritage	120′	To ensure that the working group gains awareness about cultural heritage.
Session 5	Cultural Elements of Antalya	120′	To enable the working group to recognize/reinforce the cultural elements related to the city they live in.
Session 6	Memory Places 1	120′	To raise awareness of the working group about the basics of memory places.
Session 7	Memory Places 2	120′	To ensure that the working group has knowledge about memory places.
Session 8	Meeting Pierre Nora	120′	To enable the working group to internalize the memory places.
Session 9	Memory Spaces Seminar	60′	To enable the working group to overcome their lack of knowledge about memory places.
Session 10	Ready to Touch Your Memories?	120′	To enable the study group to discover their own and their family's memory places.
Session 11	A Treasure in Out-of-School Learning Environments: Memory Places	120′	To enable the study group to distinguish memory places in out-of-school learning environments.
Session 12	Return with Drama Techniques	120′	To ensure that the study group's retrospective knowledge deficiencies are eliminated.
Session 13	Memory Places of Antalya 1	120′	To enable the study group to gain awareness about the memory places of the city they live in.
Session 14	Memory Places of Antalya 2	120′	To enable the study group to learn and internalize the memory places of the city they live in.
Session 15	Curriculum Development Meeting	120′	To enable the study group to explore memory places in the 2018 Social Studies Curriculum.
Session 16	Memory Places in Social Studies	120′	To enable the study group to discover memory places in social studies subjects.

Session 17	Out-of-School Excursion Plan	120′	To look at the readiness of the study group about the out-of-school trip plan and to ensure that they have knowledge about preparing a plan.
Session 18	The Memory of Social Studies: Masquerade	120′	To enable the study group to assimilate memory places in the field of social studies and to reinforce the subject.
Session 19	Return with Discussion Techniques	120′	To complete the retrospective deficiencies of the study group through discussion techniques.
Session 20	Conversation with Experts	90′	To inform the study group about Antalya's memory and memory places through field experts.
Session 21	Memory Places of Akdeniz University	120′	To raise awareness about the memory places (personal memory places) of the university (immediate surroundings) where the study group studied.
Session 22	Explore the Place, Make a Plan	120′	To enable the study group to identify an out-of-school learning environment and prepare a lesson plan for the relevant place.
Session 23	Weaving Factory Excursion	120′	To enable the study group to solve the mystery of the Weaving Factory, which is an out-of-school learning environment (enabling them to discover memory places).
Session 24	Museum of Personal Memory Place	120′	To enable the working group to better understand the memory places by bringing the elements reflecting their personal memory spaces to the classroom environment and introducing them.
Session 25	Let's Get to Know Zeytinpark	60′	To enable the study group to discover the characteristics of an area such as Zeytinpark as a memory place.
Session 26	Cumhuriyet Square	90′	To enable the study group to discover the characteristics of Cumhuriyet Square as a memory places.
Session 27	Kaleiçi	90′	To enable the working group to discover the characteristics of Kaleiçi as a place of memory.
Session 28	Introducing Zeytinpark - Short Film Presentation	120′	To enable the working group to discover Zeytinpark and introduce it from their own perspectives with a short film.
Session 29	Theoretical Course- Memory Places Lesson Plan	60′	To enable the study group to overcome their deficiencies in preparing an out-of-school lesson plan including memory places before the trip.
Session 30	A Place of Memory: Zeytinpark Meeting with Students	120+120	To enable the study group to apply the out-of-school lesson plan they prepared by associating it with memory places to secondary school students in an out-of-school environment.

During the application, at the end of each session, pre-service teachers were asked to provide written responses to reflective questions: "What did I feel, what did I notice, what did I learn?" as an evaluation of the session. At the end of the application, Interview Form 2 was administered to the pre-service social studies teachers. Interview Form 2 comprises questions

from Interview Form 1 and additional questions evaluating the application process. Lastly, on the final day of the application, the pre-service social studies teachers were asked to conduct lesson plan activities related to memory places suitable for their courses, aligning with the primary objective of the research, and these plans were evaluated.

2.4. Data Analysis

The data obtained from the application of Interview Forms 1 and 2 were analyzed using descriptive analysis, a method of qualitative analysis. In descriptive analysis, the gathered data are summarized and interpreted according to previously determined themes. The objective of such analyses is to present the findings in an organized and descriptive manner to the reader (Yıldırım & Şimşek, 2013).

The data from the evaluated sessions were descriptively presented in the categories of "what I felt/what I noticed/learned" based on the opinions of three faculty members and two doctoral students specializing in social studies. The overall judgment of the study group was presented supported by direct quotes. Likewise, the outdoor lesson plans made by the study group were presented under four headings with expert opinion and supported by direct quotes.

The credibility of a qualitative study equates to the internal validity of a quantitative study (Yıldırım & Şimşek, 2013). The credibility of this research was ensured by:

- Realistic and acceptable creation of the action idea;
- Detailed and understandable development of action steps;
- Video recording of the entire application process with examples provided in appendices;
- Step-by-step documentation of the application process with date and location information;
- Sharing data collection tools in appendices;
- Validating the entire action process's duration with expert opinions.

Additionally, for discussing and deliberating the action steps of the research, a small group consisting of three faculty members specializing in social studies, two doctoral students, and three master's students was formed. This group evaluated the end-of-session feedback, session products, and images after each session. The researcher described the next action plan after each session, and the group shared their opinions about the plan.

The reliability of the collected data was enhanced by conducting it with two other experts in the field, separate from the researcher. The reliability calculation was done using Miles and Huberman's (1994) formula: R(Reliability) = [Na (Agreement) / Na (Agreement) + Nd (Disagreement)] x 100. The reliability analyses for "Pre-service Social Studies Teachers' Pre-Application Views" was found to be 91%, and for "Post-Application Views" it was 93%. Based on these findings, the research was deemed reliable. Expert opinions and direct quotes for the session analyses and plan analyses were considered sufficient. Additionally, to enhance validity, the study's findings were supported with direct quotes from the participants' views (1MPST: 1st Male pre-service teacher; 1FPST: 1st Female pre-service teacher).

3. Findings

3.1. Findings on Pre-service Teachers' Readiness Before the Application

Views of Pre-service Teachers on Out-of-School Learning Environments

When pre-service social studies teachers were asked about their views on out-of-school learning environments prior to the application, it is possible to state that they mentioned museums, historical places, zoos, factories, science and arts centers, various trips to different environments, learning in out-of-school learning environments, active learning occurring in all fields, widespread learning environments, social learning, experiential learning, and the application of theoretical lessons to practice. Considering the responses of the pre-service teachers, it is possible to say that they are aware of out-of-school learning environments based on the examples they provided. Some of the responses given by the pre-service teachers are:

> "Out-of-school environments are places where students can continue their education in their social lives. In these environments, students can usually learn more easily and at their own pace, as they are generally less formal. These places can include museums, zoos, exhibitions, etc." FPST7

> " When thinking of out-of-school, I think of field trips to historical and cultural sites in the student's surroundings." 1MPST "People continue to learn in the environments they live in. When it comes to out-of-school learning, I believe learning can occur in all areas". FPST8

Assessments on the Need for Out-of-School Learning Environments in Service

When pre-service social studies teachers were asked to evaluate the need for out-of-school learning environments during service, they stated that these environments ensure the retention of learned material, can be used to concretize information in cases where schools are inadequate, facilitate learning through fun and active participation, create an environment for

experiential learning, effectively convey lessons, solve the time problem in schools, and reinforce learning. In this context, it is possible to say that pre-service teachers believe that out-of-school learning should be included in the teaching process.

Some responses given by the pre-service teachers are:

> "Out-of-school learning helps concretize information for students, thus meeting a teacher's need in situations of abstract learning." MPST1

> "…The information presented in school is generally theoretical. Higher levels of experience and symbols mentioned in Edgar Dale's Cone of Experience can be utilized. However, out-of-school learning environments facilitate a positive transition from abstract to concrete and towards learning involving multiple senses." MPST4

Examples Given by Pre-service Teachers on Antalya's Out-of-School Learning Environments and Their Association with Social Studies Topics

When pre-service social studies teachers were asked about Antalya's out-of-school learning environments, most mentioned places such as Antalya Archaeological Museum, Atatürk's House, and Kaleiçi. Additionally, among the examples given were historical sites like Aspendos, Side, and Phaselis, as well as natural formations like Damlataş Cave, Taurus Mountains, Karain Cave, Konyaaltı Beach, Manavgat Waterfall, and the cliffs. Based on the responses, it is possible to say that pre-service teachers consider natural formations, historical buildings, commercial/industrial structures, and conservation sites beneficial for out-of-school learning.

When asked to relate Antalya's out-of-school learning environments to social studies topics, the pre-service teachers predominantly indicated they could connect them to history, culture, and geography topics. Other associations made by the teachers included archaeological artifacts, learning about Atatürk, understanding the local environment, and perceiving place and surroundings. The pre-service teachers relate Antalya's out-of-school learning environments to learning areas such as culture and heritage, people, places, environments, individual and society, and active citizenship. It is possible to say that most of the responses are superficial associations as learning areas rather than detailed topical connections. Three pre-service teachers mentioned they lacked knowledge on the subject. Some of the responses given by the pre-service teachers are:

> "I would use it in the Culture and Heritage learning area. I apply these places and learning areas in the context of past and future." MPST6

> "The Culture and Heritage unit is quite broad and very difficult to understand. It can also be quickly forgotten. I teach outcomes like sensitivity to aesthetic and cultural heritage. The outcomes are broad in topic and conducive to out-of-school learning." MPST10

Situations of Preparing Lesson Plans for an Out-of-School Learning Environment in Antalya

Pre-service social studies teachers were asked to prepare lesson plans for an out-of-school learning environment in Antalya prior to the application. It is possible to state that pre-service teachers described out-of-school learning environments in Antalya by giving examples. However, when asked to prepare a lesson plan using an out-of-school learning environment, none of the pre-service teachers in the study group prepared a lesson plan related to out-of-school learning environments. This suggests that pre-service teachers might not have ideas about how to prepare lesson plans concerning out-of-school learning environments.

Thoughts on Integrative Memory Elements

Pre-service social studies teachers were asked to describe the "integrative memory elements of Antalya" before the application. All pre-service teachers in the study group expressed that they did not have knowledge about integrative memory elements and therefore could not define them.

Descriptions of Elements Determining "A Nation's Fate, Beliefs, Common Values" in Out-of-School Learning Environments

When pre-service social studies teachers were asked about their views on integrative memory elements in out-of-school learning environments, most of them cited culture, religion, traditions and customs, language, and museums as examples. It is also possible to say that historical sites, shared pasts, and religious sites were among other responses given. Nine pre-service teachers mentioned they lacked knowledge about the topic. Considering the responses and the previous question, it is possible to say that pre-service teachers are not well-informed about integrative memory elements and provided their answers through guesses and inferences rather than definite knowledge. Some of the responses given by the pre-service teachers are:

> "We can consider state-protected national parks, memorials, settlements from past periods that have remained untouched (not built over), battlefields, museums, places of worship, theater plays, and books." MPST8

> "The fate, beliefs, and common values of a nation are gathered around elements that have been accepted by the general majority, loaded with emotions and meaning, surrounding and organizing. Examples include Anıtkabir, Çanakkale, Monumental Tombs..." FPST1

Statements on Associating Integrative Memory Elements with Out-of-School Learning Environments

When pre-service social studies teachers were asked to associate integrative memory elements with out-of-school learning environments, the majority expressed that they lacked knowledge on the subject. Other prominent responses indicated that memory elements make out-of-school learning more concrete and contribute to it, out-of-school learning environments form a whole with the information stored in memory, and the places visited outside of school are memory elements. Considering the responses of the pre-service teachers, it is possible to say that they are making inferences on the topic but do not possess detailed knowledge. Some of the responses given by the pre-service teachers are:

> "Students can make the information they learn in school more permanent by integrating it with out-of-school learning environments. For example, they can reinforce their knowledge about Atatürk by visiting a museum to see his clothing and memorabilia." FPST3

> "Places to visit outside of school learning are memory elements. Visiting and seeing are more enduring in memory." MPST8

> "Out-of-school learning environments, that is our surroundings, are integrative memory elements, namely the historical and cultural artifacts around us. They complement each other." FPST9

Statements on Their Personal Memory Elements

When pre-service teachers were asked about their personal memory elements, the majority expressed that they lacked knowledge on the subject or did not remember. Aside from those who stated they did not know, the most notable response was holidays experienced in childhood. Considering the responses, it is evident that apart from those who said they lacked knowledge, the replies given by others could possess the characteristics of a memory place. However, the speculative nature of the responses indicates that pre-service teachers are guessing rather than speaking from informed positions. Some of the responses given by the pre-service teachers are:

> "...Birthdays are an example that has grown with me as a unifying element in my family." FPST3

> "I can see the holidays I experienced in my childhood as a unifying memory element. The reason was seeing the family together." MPST9

Statements on Antalya's Integrative Memory Elements

When social studies pre-service teachers were asked about the integrative memory elements of Antalya, most of them indicated that they lacked knowledge on the subject. The other notable

responses generally included museums, ancient places, natural features, and certain historical structures of Antalya. Looking at the responses, apart from those who expressed a lack of knowledge, it can be said that the examples given might have the characteristics of a memory place. However, considering previous discussions, it appears that the pre-service teachers provided these examples through guessing due to a lack of knowledge about memory places. Some of the responses given by the pre-service teachers are:

> "Hıdırlık Tower, Antalya Museum, Side Ancient City, Perge Ancient City, Hadrian's Gate." MPST6

> "For example, museums could be considered. Places like Ancient Cities, Atatürk's House that can unite the society might be considered memory elements. After all, this society has certain common values, a common history, and past. Therefore, these places can be cited as examples." FPST3

3.2. Findings on Pre-service Teachers' Experiences After the Application

Post-Activity Views

After the activities, most pre-service social studies teachers expressed that they felt capable of teaching using the activities, realized the significance of memory places for every individual and gained sensitivity about it, understood the importance of out-of-school learning environments in social studies, and gained a lot of experience from this work. They also noted that everyone has personal memory elements, and they learned a lot about memory places and out-of-school learning.

In line with this, when looking at how the pre-service teachers felt after the activities, many felt competent in employing various methods and techniques for teaching, felt they had developed in understanding memory places, were happy about being able to prepare out-of-school lesson plans, and felt happy for participating in a contributing study in the field. They also expressed feeling more comfortable and confident in the classroom setting.

Most pre-service social studies teachers stated that after the activities, they learned what memory places are and their contents. They mentioned that they could teach using drama activities, prepare/apply out-of-school lesson plans, create/apply lesson plans using memory places, knew about Antalya's memory places, understood the importance of out-of-school learning environments in social studies, and knew how to use these environments. Thus, it can be said that after the application, pre-service teachers shed any preconceived notions they had

before and gained both personally and socially from the study. Some of the responses given by the pre-service teachers are:

> "I think memory places are meaningful for every person, can be special to everyone, and we all might have memory elements belonging to us." FPST2
>
> "As a pre-service teacher, I believe that drama and out-of-school learning environments are indispensable at every level of education, and that all learning outcomes can be easily achieved." MPST7
>
> "Learning about memory places and how to create a tour plan has developed me. Now, I feel more relaxed and confident in the classroom (during internship)." MPST9
>
> "I feel how beneficial and educational out-of-school learning is." MPST8
>
> "Even though we might not be aware of many things, I know we have memory places, and I can prepare sufficient activity plans for students to teach them about memory places ." MPST1
>
> "I learned so much valuable information. I can make and implement tour plans, prepare and lead drama activities. I know what a memory element is, how it affects our lives, and its contributions." MPST10

Assessments on the Application

Social studies pre-service teachers were asked to evaluate the application's impact on their perspectives towards the environment, their understanding of teaching, and their personal, social, and professional development.

At the end of the application, the pre-service teachers were inquired about their views on the study's impact on their outlooks towards their environments, their teaching philosophies, and their personal, social, and professional growth. None of the pre-service teachers reported negative views. All social studies pre-service teachers assessed the impacts of the study positively.

Firstly, when looking at the pre-service teachers' views on the "impact of the application on their perspectives towards the environment," it is observed that they generally used positive expressions. Most of the pre-service teachers expressed that they became more sensitive towards their surroundings regarding memory places. Additionally, they stated that places with memories became their memory places, they adapted better to their environments, gained confidence, learned about the common memory places of society, discovered that unknown places/things also have stories, were able to create activities related to every object in their surroundings, and now look at their environments with a different perspective. From this

aspect, it is possible to say that the pre-service teachers developed a social awareness towards their environment.

Some of the responses given by the pre-service teachers regarding the impact of the application on their perspectives towards the environment are:

> "Since learning that ordinary places I visited could be memory places for cities and people, I've become more sensitive and attentive to my environment." FPST1
>
> "Now, wherever I look, I think, 'What have I experienced here?' For every street I pass, I can say, 'This is a memory place for me because of this reason.' Now I know things with memories are memory elements for me." FPST2

When social studies pre-service teachers were asked about the impact of the application on their "understanding of teaching," most indicated that they learned the importance of fun and active learning, acquired the ability to plan and use activities for out-of-school learning, and gained confidence in efficiently conducting lessons. They also learned how to create tour plans using memory places, understood that out-of-school learning and memory places facilitate students' learning, adopted the idea that lessons would not always be confined to four walls, and could provide examples from nature, our ancestors' legacy, and memory elements adopted by society in their lessons. Thus, it is possible to say that pre-service teachers' knowledge in the field has solidified, and their understanding of teaching has positively changed.

Some of the responses given by the pre-service teachers regarding the impact of the application on their understanding of teaching are:

> "I can provide examples from nature and our ancestors' legacy, daily life, and both abstract and concrete memory elements embraced by the entire society while conveying events and phenomena." MPST4
>
> "I see myself one step ahead of many teachers even before being appointed. With all these learned practices, I am ahead of a teacher continuing the traditional education approach. I see my students as motifs ready for processing. I will add the most beautiful aesthetics to them by applying what I learned in this study." MPST10

When looking at the responses about the application's contribution to their "personal development," most pre-service teachers expressed that they could better articulate themselves in public and their confidence increased, they gained knowledge and experience in many areas. They also felt more knowledgeable about out-of-school learning environments, it enabled them to look at life and the world from a different perspective, they realized the importance of their personal memory places, and understood the importance of memory places for society. From

the pre-service teachers' statements, it can be inferred that they first became aware of themselves and subsequently gained social awareness.

Some of the responses given by the pre-service teachers regarding the contribution of the application to their personal development are:

> "A handkerchief can mean a lot. The important thing is to assign value to it. I have also started to feel competent in the drama area." FPST2
>
> "I didn't know much about memory places, honestly. For example, Zeytinpark is now a very important memory place for me. I learned how to plan activities and grasped the importance of memory places for society." FPST3

When looking at the responses from social studies pre-service teachers regarding the application's "contribution to their social development," the majority expressed that the application helped them overcome shyness and strengthen their social relationships. They also noted becoming more patient, more responsible towards their surroundings, and learning that memory places frequently occur in social life. In this context, it is possible to say that the pre-service teachers were able to adapt more comfortably to society by overcoming emotions that hinder social interaction after the study. Some of the responses given by the pre-service teachers regarding the contribution of the application to their social development are:

> "Through this study, I overcame the shyness I felt outside. I can now form stronger relationships with my friends." MPST2
>
> "Before this study, I was somewhat shy even with my own classmates. But now, I feel more confident in myself." MPST5

Regarding the application's "contribution to their professional development," most pre-service teachers mentioned learning to plan and implement out-of-school activities, acquiring a student-centered classroom management style, and understanding how to relate various outcomes with memory places. They also learned various methods and techniques applicable within the classroom and expressed gaining confidence in the profession. In this context, it can be said that pre-service teachers are likely to start their profession more confidently due to the self-assurance they gained before entering the service. Some of the responses given by the pre-service teachers regarding the contribution of the application to their professional development are:

> "In my teaching career, many outcomes can be related to memory places. Besides, I learned to plan out-of-school activities." MPST1
>
> "The contribution to my professional development is immense. We learned how to create an out-of-school lesson plan and deliver outcomes. Learning to make

> educational trips, which are very fitting for social studies, more effective was very important." FPST11

Statements on Why They Should Use Out-of-School Learning Environments in Service

When social studies pre-service teachers were asked why they should use out-of-school learning environments during service, they generally mentioned that using these environments would enhance the permanence of the lesson and provide students with concrete experiences, as social studies is a subject intertwined with life. Additionally, many topics in the subject are related to out-of-school learning environments, allowing students to learn social studies, a broad and comprehensive subject, actively and permanently. From the responses, it is evident that pre-service teachers recognize the importance of out-of-school learning environments for social studies. Some of the responses given by the pre-service teachers are:

> "Because listening and experiencing are never the same. If students are taken to related learning environments, the information can be delivered more effectively." MPST3

> "Social studies is a multidisciplinary field. I couldn't imagine a subject so intertwined with art, literature, and so much else being independent of out-of-school learning environments. Due to the subject's deep connection with various sciences, I believe out-of-school learning environments are crucial for imparting lasting knowledge." FPST12

Statements on Why They Should Use Memory places in Service

When social studies pre-service teachers were asked at the end of the application why they should use memory places during service, they generally stated that memory places, offering examples from life, facilitate learning, are suitable for social studies as they hold society together, and can enhance lesson permanence as they are inherent to social studies. Moreover, a pre-service teacher expressed that memory places are a collection of concrete or abstract information, emotions, and memories that unite people at a common point, making them necessary for social studies. Considering the responses, it is possible to say that the application served its purpose, and all pre-service teachers are knowledgeable about the importance and definition of memory places in the field of social studies. Some of the responses given by the pre-service teachers are:

> "Memory places are an entirety of all our emotions, encompassing everyone with concrete or abstract information, memories, and feelings. Teachers can unite students with different socio-cultural characteristics around memory places." MPST4

> "This course, aiming to cultivate good citizens, cannot be independent of memory places /values that give meaning to us. For instance, the Grand National Assembly of Turkey building, a memory place itself, can be taught very effectively with active

> participation in the area of active citizenship. Each outcome speaks to at least one memory place, and as memory places are the values that make us, they directly serve the purpose of this course." FPST10

Statements on the Similar and Different Aspects of Out-of-School Learning Environments and Memory places

When social studies pre-service teachers were asked about the similar aspects of out-of-school learning environments and memory places, generally, they expressed that memory places and out-of-school learning environments affect each other. Meaning, memory places can be out-of-school learning environments or out-of-school learning environments can contain memory places. Additionally, they noted that both contribute to permanence through observation and connection to the past, facilitate short-path acquisition using common objects and outcomes, and enable learning through fun and effective lesson conveyance. Thus, it is possible to say that pre-service teachers understand the characteristics of both memory places and out-of-school learning environments and can articulate their similarities. Some of the responses given by the pre-service teachers are:

> "Many out-of-school learning environments are actually memory places. For example, Çanakkale Martyrs' Memorial, Anıtkabir, museums etc. These are more material items loaded with value and meaning." MPST1

> "A common element in the collective memory of the society can also be an out-of-school learning environment. For instance, the nostalgia tramway in Antalya is a memory place, but it can also enhance understanding of transportation activities in a social studies class through an external visit. I believe both have common elements in terms of reinforcing concepts, making them concrete, and ensuring permanence." FPST12

Regarding the differing aspects of out-of-school learning environments and memory places, pre-service teachers generally mentioned that memory places could have different meanings for individuals, whereas out-of-school learning environments tend to evoke the same thing for people. Additionally, most pre-service teachers stated that memory places could be any concrete or abstract thing, but out-of-school learning environments need to be a specific place. Considering the responses, the majority of pre-service teachers articulate differences between memory places and out-of-school learning environments, while one suggests that there is no differentiation as out-of-school learning environments encompass memory places. Hence, it is possible to say that pre-service teachers are proficient in explaining the differences between memory places and out-of-school learning. Some of the responses given by the pre-service teachers are:

> "I don't see a differing aspect. In fact, out-of-school learning environments become more meaningful as they encompass memory places." MPST6
>
> "Memory places vary for each individual. A stone or a plant can be a memory place for someone. Out-of-school learning environments mean the same for everyone." MPST5

Statements on Learning Areas and Outcomes Related to Memory places in the Social Studies Curriculum

At the end of the application, social studies pre-service teachers were asked to provide examples of learning areas and outcomes related to memory places in the Social Studies Curriculum.

Table 2.

Learning Areas and Outcomes Related to Memory Places

Learning Domain	**Achievements**	***f***
People, Places and Environments	SB.4.3.3. Distinguishes natural and human elements in the environment they live in.	3
	SB.5.3.3. Gives examples of the effects of natural features and human features on population and settlement in and around the place where they live.	1
Production, Distribution and Consumption	SB.4.5.2. Recognizes the main economic activities in his/her family and immediate surroundings.	5
	SB.5.5.2. Recognizes the professions that develop depending on the economic activities in and around the place where they live.	1
	SB.5.5.4. Analyzes the production, distribution and consumption network of products to meet basic needs.	1
	SB.6.5.2. Analyzes the effects of unconscious consumption of resources on living life.	1
	SB.7.5.2. Evaluates the effects of developments in production technology on social and economic life.	1
Culture and Heritage	SB.4.2.2. Gives examples by researching the elements reflecting the national culture in his/her family and environment.	3
	SB.6.2.4. Analyzes the process of Turks' homeland of Anatolia within the scope of XI and XIII. centuries.	2
	SB.4.2.1. Makes a family history study by using oral, written, visual sources and objects.	1
	SB.5.2.1. Recognize the important contributions of Anatolian and Mesopotamian civilizations to human history based on their tangible remains.	1
	SB.5.2.2. Introduces natural assets and historical places, objects and artifacts in their environment.	1
	SB.7.2.5. Gives examples of Ottoman culture, art and aesthetics.	1
Effective Citizenship	SB.5.6.4. Values our flag and the National Anthem as symbols of national sovereignty and independence.	1

Reviewing the responses of the social studies pre-service teachers participating in the study, it is possible to say that all participants correctly identified the learning areas and outcomes

related to memory places . Pre-service teachers mostly associated memory places with the "Production, Distribution, and Consumption" learning area. In this learning area, it is possible to say that 6 outcomes at the 4th-grade level, 2 outcomes at the 5th-grade level, 1 outcome at the 6th-grade level, and 1 outcome at the 7th-grade level are related to memory places . The outcome "S.S.4.5.2. Recognizes the main economic activities in their family and immediate environment." was the most frequently associated outcome (5) by pre-service teachers with memory places .

Another learning area that pre-service teachers frequently associated with memory places is "Culture and Heritage." In the Culture and Heritage learning area, a total of 9 outcomes across various grade levels are associated with memory places : 4 outcomes at the 4th-grade level, 2 outcomes at the 5th-grade level, 2 outcomes at the 6th-grade level, and 1 outcome at the 7th-grade level. "People, Places, and Environments" is another associated learning area. It is possible to say that pre-service teachers associated 3 outcomes at the 4th-grade level and 1 outcome at the 5th-grade level with memory places in this learning area. 1 outcome is associated with the "Active Citizenship" learning area at the 5th-grade level. Additionally, from the responses, it can be said that pre-service teachers were able to make associations in "Culture and Heritage" and "Production, Distribution, and Consumption" learning areas at every grade level. Some of the responses given by the pre-service teachers are:

> "Based on the outcome 'analyzing the network of production, distribution, and consumption of products aimed at meeting basic needs,' I would take students to Antalya's memory place of a textile factory and conduct activities related to production, distribution, and consumption." MPST2
>
> "Outcome: Conducts family history research using oral, written, visual sources, and objects. Memory place: Çanakkale Martyrs' Memorial. Learning Area: Culture and Heritage." FPST12
>
> "Outcome: Researches and provides examples of elements reflecting the national culture of their family and environment. The learning environment is Atatürk's house, and the photo representing Atatürk's visit to Antalya is the memory place." MPST1

Thoughts on Associating Memory places with the Field of Social Studies

Social studies pre-service teachers were asked at the end of the application to associate memory places with the field of social studies. All participants expressed that they were able to relate memory places to the field of social studies. When considering their thoughts on the association, generally, they mentioned that "social studies and memory places have many common topics,

both are areas and subjects embedded in life, both unite society, memory place objects are present in the outcomes of social studies, memory places are the manifested content of social studies, both are related to cultural heritage, and both fundamentally concern human beings." Based on these explanations, it can be said that pre-service teachers consider memory places and the field of social studies to be intertwined and connected. Some of the responses given by the pre-service teachers are:

> "I associate memory places with the field of social studies because our lessons address the past and the future, and memory places remind us of the past." FPST7
>
> "I relate memory places with the field of social studies because memory places are the manifested form of social studies content. The core subjects of social studies are mostly memory places themselves." MPST4

3.3. Findings on the Evaluation of the Study Group's Plans for Using Memory places in Social Studies Classes after the Application

Social studies pre-service teachers were asked to create a tour plan based on a specified memory place. The social studies pre-service teachers in the study group selected a relevant outcome from the social studies curriculum and prepared lesson plans for a chosen memory place, Zeytin Park in Antalya. On the final day of the application, they implemented their plans with a group of primary and middle school students who came to Zeytin Park for a tour at that time. After the tour, participants were given back their plans and asked to evaluate them in the context of their implementation.

The Ability of Pre-service Teachers to Present the Specified Place as a Memory place in the Tour Plan

In examining the plans of the study group's pre-service teachers, it can be said that they were generally able to showcase the designated place as a memory place. 20 participants reflected the significance of Zeytin Park for Antalya as a memory place in their plans, focusing on its historical importance, contribution to labor force, and its significance and unifying role for the people of Antalya through their activities. However, 3 participants showcased Zeytin Park primarily as an important out-of-school learning environment for Antalya. While they highlighted the park's ancient trees as a memory element, their plans were somewhat lacking in portraying it as a memory place for Antalya. Some excerpts from the participants' plans are:

> FPST7. Activity 3: Antalya's Lungs. You've been cleaning the air of this city for years. You are the oldest of all trees. What have you seen, what have you experienced? Now, speak to the other trees about what you've seen in this city.
>
> MPST6. Activity 2: The Secret of Antalya is in Zeytin Park. There's a historical tree in Zeytin Park. Find that tree. What might this tree have witnessed? Think about it.
>
> FPST10. Activity 3: Touch Me. Let's talk to the century-old olive tree in Zeytin Park. What might this tree have contributed to the city in the production-consumption cycle?
>
> FPST13. Activity 1: Zeytin Park is Calling You. What comes to mind when you hear you will visit Zeytin Park? Which social studies topic does this place remind you of?

Pre-service Teachers' Ability to Select Appropriate Learning Area, Outcome, and Grade Level for the Memory place Tour Plan

Upon reviewing the plans of the pre-service teachers in the study group, it was generally observed that they selected outcomes from the learning areas of "People, Places, and Environments," "Culture and Heritage," and "Production, Distribution, and Consumption." 13 participants approached the place historically, 4 geographically, and 6 economically in their planning. Additionally, all participants were able to choose appropriate outcomes and grade levels for Zeytin Park. Some excerpts from the participants' plans are:

> FPST3. Grade: 5 Learning Area: Culture and Heritage Outcome: Introduces the natural assets, historical places, objects, and artifacts in their environment.
>
> FPST1. Grade: 4 Learning Area: People, Places, and Environments Outcome: Distinguishes between natural and human elements in their living environment.
>
> FPST8. Grade: 5 Learning Area: Production, Distribution, and Consumption Outcome: Relates the country's resources to economic activities.

Pre-service Teachers' Implementation of Plan Steps and Use of Methods in the Memory place Tour Plan

Upon reviewing the plans of the pre-service teachers in the study group, it is possible to say that all of them correctly implemented the lesson plan steps in their plans. Pre-service teachers have gained proficiency in preparing plans for an out-of-school learning environment and relating the out-of-school learning environment to memory places within the scope of social studies lessons compared to before the applications. Additionally, when looking at their plans, 15 pre-service teachers used drama, and 8 used the excursion observation method in their plans.

Pre-service Teachers' Evaluation of Their Activities and Performance After Implementing Their Plans

After implementing their plans, the pre-service teachers in the study group were asked to evaluate their activities and performance based on the plans. Upon reviewing these evaluations, all participants stated that they emphasized the memory place element in their implementations, were able to relate it to social studies, and managed to complete their plans. Four participants expressed difficulty in giving directions while implementing the plan, six found it challenging to respond to students' questions, and two mentioned that students struggled to provide the desired feedback in drama activities. Additionally, 12 pre-service teachers expressed having a very productive experience and found conducting a class outside to be very enjoyable. Nine pre-service teachers were very pleased with the final activity of their training and felt they had the opportunity to fully express themselves. It can also be said that all participants indicated a full adoption of the concept of memory place in their expressions. Some excerpts from the participants' plan evaluations are:

> FPST12: I believe I was quite successful in implementing my plan. It was the ultimate final activity. We went through training and creating a practical example was very fruitful. Even though there were issues arising from the students (understanding instructions, focusing their attention, movements in the place, etc.), I believe they had an unforgettable experience related to the memory place. The biggest shortcoming in this journey was my inexperience. The best part was knowing beforehand how to deliver such a powerful element as memory places in such an effective location. I didn't have much trouble with time. The learning area and outcome I chose were perfect for this place. In social studies, every place is an out-of-school learning environment, and within these learning areas are hidden treasures: the memory places . I think they got this message, but most importantly, neither they nor we will forget today.
>
> MPST4: I had no issues with timing in my plan. I believe the outcome and topic I chose were suitable. The students mentioned that it was their first time doing such an activity in an outdoor setting. This was a significant feedback for me. They were unfamiliar with the memory place, which is natural, but they didn't dwell on it. They understood that it's an important place for the people of Antalya, a historical, economic, and cultural bridge from the past to the present. I asked the students if they had ever had a social studies class like this before. They used to perceive excursions as fatigue, chaos, or an escape from class. I believe today I've shattered that perception. Preparing a lesson plan, an outdoor lesson plan, and specifically for a memory place was a very different experience.

4. Discussion and Conclusion

This research was conducted using the action research model to enable social studies pre-service teachers to recognize memory places that can be considered out-of-school learning environments, relate them to social studies education, and demonstrate how to use these memory places in their field. The results obtained for the purpose of the research have been examined in three groups: readiness before the application, experiences and views after the application, and results related to out-of-school lesson plans after the application. The results of the research are explained below in order.

4.1. Results Related to Readiness for Out-of-School Learning Environments and Memory places Before the Application

By examining the responses of the pre-service teachers, it can be concluded that although not in detail, the pre-service teachers had an idea about out-of-school learning and could distinguish and provide examples of out-of-school learning environments that could be used in their surrounding area.

When examining the findings related to how pre-service teachers relate out-of-school learning environments with social studies topics, it was observed that they predominantly mentioned they could associate these environments with history, cultural topics, and geography. However, it appears that pre-service teachers' efforts to relate out-of-school learning environments with social studies topics remained superficial. From this, it can be concluded that while social studies pre-service teachers can list out-of-school learning environments in their surroundings, they lack in-depth association with their field. Çengelci (2013)'s study aimed at revealing social studies teachers' views on out-of-school learning showed that participating teachers mostly benefited from out-of-school learning in teaching history and geography topics. They mentioned conducting trips to historical sites nearby for history topics and utilizing local resources for climate, vegetation, and minerals in geography topics. This study shows similarities with the results of the current research. Another similar study is by Coşkun Keskin and Kaplan (2012), which aimed to explore how toy museums as out-of-school learning environments can provide children with perspectives and skills in social studies and history education. The study concluded that toy museums as out-of-school environments could be utilized to enhance skills related to social studies and history education among students,

showing similarities with the results of this research in terms of the contributions of museums, as one of the out-of-school learning environments, to learning.

Upon examining the findings related to the ability of pre-service teachers to prepare a lesson plan for an out-of-school learning environment, it was observed that none of the pre-service teachers were able to prepare a lesson plan specific to an out-of-school learning environment. This indicates that pre-service teachers do not know how to utilize an out-of-school learning environment in social studies, suggesting that even if they know the environment and organize a trip, they will not achieve the trip's purpose without a specific plan. Considering that a trip to an out-of-school learning environment for a social studies class should be conducted within the framework of a topic and outcome, the inability to prepare a plan shows a deficiency since pre-service teachers need to be capable of planning not only the lesson but also an outdoor trip. Bozdoğan (2012) in his applied study on planning trips to out-of-school environments found that a majority of pre-service teachers did not feel confident about planning a trip before the applications.

It was observed that none of the pre-service teachers were able to define unifying memory elements. This suggests that pre-service teachers are not knowledgeable about unifying memory elements. However, when unifying memory elements were explained to pre-service teachers as "factors determining the fate, beliefs, and shared values of a nation," they provided responses. The fact that pre-service teachers responded after the explanation suggests that although they might be aware of certain subtopics covered by memory places, they do not have explicit knowledge that these are considered memory places and have responded based on the explanation provided.

When examining the findings related to pre-service teachers' ability to associate out-of-school learning environments with unifying memory elements, it was found that the majority of pre-service teachers were unable to make such associations. This could be due to a lack of sufficient knowledge about how to use out-of-school learning environments and unifying memory elements. Furthermore, when examining the findings related to pre-service teachers' personal memory elements, it is generally concluded that they are not knowledgeable about the subject.

When examining the findings related to pre-service teachers' views on the unifying memory elements of Antalya, it is generally noted that they were unable to respond. Those who did respond often cited museums, historical sites, and natural beauties as examples.

4.2. Results Related to Experiences, Views, and Associations with Social Studies of Memory places and Out-of-School Learning Environments After the Application

Upon examining the findings related to what pre-service teachers learned after the application, the statements "definition and content of memory place, teaching with the drama method, preparing and implementing a lesson plan using memory place, implementing and preparing an out-of-school lesson plan" were notable. From this, it is inferred that the pre-service teachers provided consistent responses in line with what they did not know before the application and what they learned as a result, indicating that the research achieved its objective.

At the end of the applications, it can be concluded that pre-service teachers gained awareness towards their environment and were able to relate the topic of memory places to life, increasing their social adaptation. The applications and chosen educational philosophies seem to have reinforced a constructivist attitude in their understanding of teaching among social studies pre-service teachers. In Karatekin et al.'s (2017) study aiming to identify memory places in Kastamonu and assess these places from a social study teaching perspective, it was found that teaching social studies using memory places facilitated experiential learning, increased interest in subjects and lessons, and enhanced students' active participation in the learning process. This result shows similarity with the outcome of this research.

At the end of the study, it can be suggested that social studies pre-service teachers, by learning about memory places, enhanced their personal development and awareness towards the environment. The activities performed using various methods and techniques during the applications seem to have increased their societal adaptation and professional competencies, especially in integrating newly acquired information into their professional knowledge.

When examining the findings related to why pre-service teachers should use out-of-school learning environments in service, the explanations provided by the pre-service teachers regarding the necessity of using out-of-school learning in social studies indicate that they are knowledgeable about out-of-school learning and competent enough to justify its use. This aligns with Malkoç and Kaya's (2015) study on identifying out-of-class school environments

used in teaching social studies. In that study, teachers indicated that these environments facilitated permanent learning, concretized knowledge, and provided opportunities for experiential learning and extracurricular activities. They also emphasized that out-of-class school environments supported students' socialization. Additionally, Öner (2015)'s research on out-of-school history teaching with teachers revealed that out-of-school history teaching improved retention of knowledge and increased interest in the subject. In this regard, the study shows similarity with the results of this research.

In the study conducted by Avcı and Öner (2015) to reveal social studies teachers' views and suggestions on teaching social studies with historical places, it was found that teaching with historical places would concretize students' knowledge, make it permanent, provide opportunities for active and experiential learning, foster curiosity and interest in history, and develop a sense of guardianship and preservation of cultural heritage. Similarly, Çepni and Aydın's (2015) study on the views of social studies teachers about out-of-class school environments suggested that utilizing these environments would increase the retention of information in social studies teaching, contribute to experiential learning, make learning enjoyable, and concretize topics. This study shows similarity with the results of the research.

The necessity expressed by pre-service teachers for using memory places in-service indicates that they have internalized the concept of memory places and can relate it to their field. This aligns with Karatekin et al.'s (2017) study on identifying memory places in Kastamonu and evaluating them in terms of social studies teaching, which posits that "using memory places in social studies lessons will help students concretize information, develop historical empathy, perceive continuity and change, compare the past with the present, and gain national historical consciousness."

When examining the findings related to the similarities between out-of-school learning environments and memory places, it is possible to conclude that the two concepts are intertwined and highly related. Moreover, the findings suggest that, despite their relatedness, pre-service teachers understand the distinct aspects of these concepts.

When examining the findings regarding pre-service teachers' understanding of memory places in relation to the Social Studies Curriculum's learning domains and achievements, prominent areas include "People, Places, Environments, Culture and Heritage, Production, Distribution,

Consumption, and Active Citizenship." It's evident that not only are the achievements related to memory places, but they are also applicable in out-of-school learning environments. This suggests that pre-service teachers grasp the significance of memory places within out-of-school learning contexts. Çapkin's (2018) study aimed at identifying memory places in social studies textbooks found that "Culture and Heritage" and "Global Connections" learning areas featured memory places most frequently, while "People, Places, and Environments" had the least. The associations made by pre-service teachers between memory places and learning domains in this research show similarities with Çapkin's findings. Similarly, in a study conducted by Coşkun Keskin and Kaplan (2012) with students in a toy museum as an out-of-school learning environment, it was found that students emphasized topics forming the content of social studies and history education, including past periods, events of those periods, social life of communities, economy, and culture. In this respect, the study aligns with the outcomes of the current research.

Examining the findings related to pre-service teachers' associations between the field of social studies and memory places shows that they are aware of the significant aspects of both and can relate memory places to social studies, highlighting their importance within the subject. Similarly, in Karatekin et al.'s (2017) study to identify memory places in Kastamonu and evaluate them in terms of social studies teaching, it was concluded that knowledge, skills, values, and attitudes related to a society's history and culture could be conveyed through memory places. This suggests that memory places play a role in unifying society. In this context, the study displays similarities with the results of this research.

4.3. Results Related to the Evaluation of Plans for Using Memory places in Social Studies Lessons After the Applications

Upon reviewing the findings related to the plans prepared by the study group for using memory places in social studies lessons after the application, it is observed that the pre-service teachers demonstrated the designated place as a memory place. However, the plans were found to be somewhat weak in illustrating the place as a "memory place of Antalya," possibly due to the presence of many prominent memory places in Antalya. The study group has appropriately chosen the class level and learning outcomes related to the designated place. Additionally, it can be said that all pre-service teachers applied the steps of the lesson plan correctly in their

prepared plans. This suggests that, compared to before the application, pre-service teachers have gained competence in preparing a plan for an out-of-school learning environment and associating it with a memory place within the context of social studies. Bozdoğan's (2012) study on trip applications in out-of-school learning environments concluded that, after the applications, nearly all pre-service teachers provided detailed and explanatory information on planning a trip.

Overall, it is feasible to say that the plans were as expected. The pre-service teachers have been successful in preparing and implementing a plan after 30 sessions. In terms of the research, the findings of the study reflect that the pre-service teachers have completed their training successfully. Thus, it can be said that the pre-service teachers, compared to before the research, have gained significant experience pre-service and will start their in-service teaching more equipped.

5. Recommendations

Studies can be conducted to analyze how memory places are incorporated in the field of social studies, including examinations of curricula and textbooks. Memory places in the immediate vicinity and across Turkey can be identified, and research can be conducted on their applicability in social studies. The knowledge and skills of social studies teachers regarding the application of memory places can be enhanced. To this end, effective and continuous in-service training programs related to the application process of memory places can be organized. Consciousness about memory places can be developed among pre-service teachers prior to entering the service.

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Research Article

Artificial Intelligence Literacy: An Adaptation Study

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Abstract

The purpose of this research is to adapt the Artificial Intelligence Literacy Scale (AILS) developed by Wang et al. (2022) into Turkish and study its validity and reliability. The scale aims to measure the artificial intelligence literacy levels of non-expert adults. The research data were gathered from 402 participants, and the researchers did Confirmatory Factor Analysis (CFA) to test the validity of the adapted scale, and to test the reliability, they adopted Cronbach's alpha technique. The adapted scale consists of 12 items and 4 factors, as is the case in the original version. CFA results indicate that X^2/df =1.82, RMSEA = 0.04, RMR = 0.03, NFI = 0.95, CFI = 0.98, GFI = 0.96 and AGFI = 0.94. Considering CFA results, it is concluded that the adapted scale is a good fit. As for reliability, as far as the factors are concerned, the internal consistency results are 0.72, 0.74, 0.76, and 0.72 respectively. Additionally, α=0.85 for the whole scale. Consideringly, the scale and its factors are adequately reliable, and the adapted scale can be used in Turkish culture.

Keywords: Artificial Intelligence, AI literacy, Digital literacy, AI literacy scale

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Yapay Zekâ Okuryazarlığı: Bir Ölçek Uyarlama Çalışması

Özet

Bu çalışmada Wang ve diğerleri (2022) tarafından geliştirilmiş Yapay Zekâ Okuryazarlık Ölçeği'ni Türkçe diline uyarlayarak güvenirlik ve geçerliliğinin incelenmesi amaçlanmıştır. Ölçek yapay zekâ konusunda uzman olmayan yetişkin bireylerin yapay zeka okuryazarlık düzeylerini ölçmeyi amaçlamaktadır. Çalışma kapsamında 402 katılımcının oluşturduğu yetişkin bireylerden veri toplanmıştır. Ölçeğin geçerliliğini test etmek amacıyla doğrulayıcı faktör analizi yapılmıştır. Güvenirliği için ise Cronbach Alpha iç tutarlılık katsayısı hesaplanmıştır. Dört boyut ve 12 maddeden oluşan Yapay Zeka Okuryazarlığı Ölçeği için yapılan doğrulayıcı faktör analizinde; $x2/df$ için 1.82, RMSEA için 0.04, RMR için 0.03, NFI için 0.95, CFI için 0.98, GFI için 0.96 ve AGFI için 0.94 değerlerine ulaşılmıştır. Elde edilen uyum indeksleri değeri sonucunda modelin iyi bir uyuma sahip olduğu ortaya konulmuştur. Güvenlik analizi için yapılan Cronbach's Alpha iç tutarlılık katsayısının hesaplanmasında ölçeğin alt boyutları için sırasıyla 0.72, 0.74, 0.76, 0.72 değerlerine ulaşılmıştır. Ölçeğin tümü için 0.85 iç tutarlılık katsayısı hesaplanmıştır. Buna göre ölçeğin hem boyutları hem de tamamı için elde edilen değerler ölçeğin güvenirliğine yönelik yeterli kanıtlar sunmaktadır. Türkçe diline uyarlanan yapay zekâ okuryazarlık ölçeği'nin, yapay zekâ konusunda uzman olmayan yetişkin bireylerin yapay zeka okuryazarlık düzeylerini ölçmek için geçerli ve güvenilir bir ölçme aracı olduğu sonucuna ulaşılmıştır.

Anahtar Kelimeler: Yapay Zekâ, Yapay Zekâ Okuryazarlığı, Dijital okuryazarlık, Yapay Zekâ Okuryazarlığı Ölçeği

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1. Introduction

The article "Computing Machinery and Intelligence" by Turing is considered a milestone for artificial intelligence (AI) studies (Topal, 2017). Turing (1950) states that machines would eventually compete with humans. Only six years after the abovementioned article, a group of scientists coined the term "Artificial Intelligence" for the first time at a conference held at Dartmouth College, US, in 1956 (Öztürk & Şahin, 2018). Later on, studies on AI followed an up-and-down path for a considerably long period. Although AI studies were well funded until the 1970s, in 1973, first the USA and then the UK made a major cut in funds due to lack of success. This period was named the AI winter. However, in the 1980s, thanks to Japanese funds, there was a great increase in the number of AI studies again (Haenlein & Kaplan, 2019). Moreover, expert AI systems, aiming to help people to make decisions, were introduced in the 1970s and became popular in the 1980s. Nevertheless, they were not very successful in the end, despite the great interest. However, the most striking leap in AI studies happened in the 1980s with the increasing interest in artificial neural network (ANN) models. Unlike expert AI systems, ANN was able to learn from data and was more successful (Alpaydın, 2004). On account of new approaches in ANN models and learning algorithms and advances in computer technology, today AI is used in computers, mobile phones, smartwatches, and even in refrigerators. The revolutionary development of AI is clear in many areas such as Industry 4.0, cancer diagnostics, Instagram effects, the defense and space industry, autonomous vehicles, and energy management networks (Gür et al., 2019).

AI is getting a place in daily life at a speed that no technological tool has ever reached before. For example, ChatGPT, developed by OpenAI, reached 100 million users in January 2023, just two months after its launch in November 2022 (Lo, 2023). Developments in AI technologies have reached a size that can affect the global economy, too. It is estimated that AI, which had a market size of 454 billion dollars in 2022, is expected to reach a market size of 2.5 trillion dollars in 2032, and that the active use of AI can contribute 16 trillion dollars to the global economy in 2030 (Karpunina et al., 2020; Precedence Research, 2023). It is anticipated that AI will continue to be more and more influential in daily life each day. That's why, the AI-human relationship or the human approach towards AI technologies is considered an important issue.

Yavuz Aksakal and Ülgen (2021), state that with the emergence of AI, some of the professions existing today will change, and some new professions will emerge in the future. For that reason, equipping human resources with the skills that will be needed in future professions is among the issues that should be paid attention to. One of these skills is "AI literacy". Literacy is about meaning construction, which is a higher-level mental process different from reading-writing skills which includes interpretation, evaluation, and construction (Kurudayıcıoğlu & Tüzel, 2010). Therefore, AI literacy, unlike literacy, usually refers to making sense of AI. Çelebi et al. (2023) define AI literacy as a set of skills that enable individuals to critically evaluate AI technologies, understand AI concepts, and have the ability to use them in practical applications, as well as ethically and effectively use AI in their daily lives. Similarly, Long and Magerko (2020) state that some skills such as digital literacy and data literacy overlap with some competencies of AI literacy. Therefore, these skills are highly related.

Artificial intelligence can have various factors like technical (McDermid, 2021), social, ethical, legal, and responsibility (Rosemann & Zhang, 2022). These factors are indicators of various impact areas of artificial intelligence. The Artificial Intelligence Literacy scale developed by Wang et al. (2022), which was adapted into Turkish, consists of four factors, of which awareness is about the ability to understand AI technology, and measures one's ability to recognize AI technology; usage is about the ability to use AI technology efficiently and to successfully integrate AI tools into one's life; evaluation is about the ability of users to choose the right AI applications, reflect on the results and critically evaluate them; ethics is about one's ability to recognize the responsibilities associated with the use of AI technologies and to understand ethical issues accurately.

The literature review indicates that there are various adaptations (Akkaya et al.,2021; Kaya et al. 2022; Schepman & Rodway, 2020; Terzi, 2020) and development studies (Ferikoğlu & Akgün, 2022; Grassini, 2023; Kaya et al., 2022; Kieslich et al., 2021; Kim & Lee, 2023; Schepman & Rodway, 2020; Suh & Ahn, 2022; Wang et al., 2022) as far as artificial intelligence is concerned. Each of those scales measures a different aspect of AI. The fact that the majority of the scale development studies found in the literature review have recently been done is due to the increasing popularity of artificial intelligence, which is rapidly developing in the field of science

and technology, and new knowledge is emerging about its future applications and possible effects.

Apart from the AILS developed by Wang et. al (2022); there are three other scales developed to measure the AI literacy levels of participants who are not experts in AI. General AI Literacy (GAIL) developed by Pinski and Benlian (2023) is a seven-point Likert-type scale consisting of 13 items, and five factors called "AI technology knowledge, human actors in AI knowledge, AI steps knowledge, AI usage experience, and AI design experience". The scale was applied to a small group of 50 people. However, the fact that people with a certain level of programming knowledge were asked to participate may indicate that this scale is not a general scale aiming to measure the AI literacy levels of individuals who are not experts in AI. The Meta AI Literacy Scale (MAILS) developed by Carolus et al. (2023) is a 34-item scale developed in five-point Likert type, and consists of four factors called "AI literacy, create AI, AI self-efficacy, and AI self-competency". However, this scale not only aims to measure the AI literacy of individuals but also aims to measure the psychological competencies of participants regarding AI. Lastly, a Delphi study was done by Laupichler et al. (2023a) to develop an item set for the assessment of non-experts' AI literacy. The 37 items identified in this study were later used by Laupichler et al. (2023b) to develop the Scale for the assessment of non-experts' AI literacy" (SNAIL). After exploratory factor analysis, they reached a structure consisting of three factors called "Technical Understanding, Critical Appraisal, Practical Application" and 31 items.

A thorough literature review indicated that although there are various scales for artificial intelligence, there is no scale measuring the artificial intelligence literacy levels of participants. That's why, the researchers thought that adapting the Artificial Intelligence Literacy scale into Turkish to determine the artificial intelligence literacy levels of participants would contribute to the literature. With this in mind, the purpose of this research is to adapt the Artificial Intelligence Literacy Scale into Turkish and to conduct validity and reliability studies.

2. Method

Methodology can be defined as the guideline for the research approach. It allows the researcher to organize, design, and conduct an effective study (Mohajan, 2017). In this research, a psychometric scale is adapted into another language, which is expected to contribute to the literature. For the adaptation process, the Artificial Intelligence Literacy Scale (AILS) was

translated into the target language. To test the validity of the scale, the researchers adopted confirmatory factor analysis; and to check the reliability, they made use of Cronbach's alpha coefficient technique.

2.1. The Artificial Intelligence Literacy Scale

The Artificial Intelligence Literacy Scale developed by Wang et al. (2022) is a seven-point Likert scale consisting of four factors and 12 items. To adapt the original scale to the target language, the researchers contacted the corresponding author through e-mail and got his permission for the adaptation. The AILS asks participants whether they agree or disagree with the research questions, and has "Strongly Agree, Agree, More or Less Agree, Undecided, More or Less Disagree, Disagree, Strongly Disagree" response options. Therefore, the lowest score to from the scale is 12, and the highest score is 84. The scale has also reverse coded items in "Awareness, Usage, Ethics" factors; one in each.

The factors of the scale are called "Awareness, Usage, Evaluation, Ethics" respectively; and each factor has 3 items. The reliability of the original scale was tested using Cronbach's alpha, composite reliability (CR), Average variance extracted (AVE), and heterotrait-monotrait ratio (HTMT). The alpha coefficients of the scale range between 0,83-0,73. The CR values range between 0,88-0,73. The AVE values range between 0,48-0,55. HTMT values range between 0,30-0,78. All reliability coefficients indicate that the AILS is reliable. The researchers report that fit results are CFI=0.99; TLI= 0.99; RMSEA= 0.01; and SRMR= 0.03.

2.2. The Adaptation

The translation process is important in adapting scales from one language to another. For correct translation, the translators should master the subtleties of both languages, in this case, both English and Turkish. With this in mind, the researchers asked two different translators to translate the original scale into Turkish. They asked another translator to translate the Turkish version into English and compared the translations. 65 participants participated in the pilot study. Eventually, the final form of the translation was prepared, and the analyses were done using SPSS 23.0 and LISREL 8.51.

2.3. The Participants

402 participants participated in the validity and reliability studies of the adapted scale. The research data was collected through Google Forms. The online form allowed no missing values, therefore, all the answers were valid. The research data were collected from a wide range of participants so that the adapted form could be used by many researchers in various samples.

Table 1:
The Demographic Data

Demographic Categories	**Variables**	*f*	%
Gender	Female	274	68.2
	Male	128	31.8
Educational Background	Primary School	6	1.5
	Secondary School	4	1
	High School	15	3.7
	Bachelor	311	77.4
	Postgraduate	66	16.4
Age	Below 20 Years old	33	8.2
	20-30 Years old	193	48
	30-40 Years old	74	18.4
	40 years or more	102	25.4
Total		402	100

3. Findings

The idea that unobservable causes affect observable phenomena has been widely accepted since mankind. When it comes to psychometric scales those unobservable constructs are called latent variables or factors which allow us to see relationships between variables that have something in common (Bollen, 2002). To get consistent results and to be able to make inferences, the researchers need to use both valid and reliable tools when they develop or adapt scales (Harrington, 2009). With this aim in mind, to check whether the adapted scale has acceptable fit indices, the researchers did confirmatory factor analysis using LISREL 8.80.

On the other hand, Gerbing and Hamilton (1996) suggest that "most uses of confirmatory factor analyses are, in actuality, partly exploratory and partly confirmatory" (p. 71). The idea behind factor analysis is that the correlations in a set of observed variables can be modeled by a smaller set of unobserved ones called factors (Hox, 2021). Confirmatory factor analysis is useful when the model(s) has a strong underlying theory (Hurley et al., 1997), and it gives the researcher a

picture of how well the model fits the data (Hox, 2021). The fit indices range between 0-1. 0 indicates a total lack of fit, however, 1 indicates perfect fit (Mulaik et al., 1989).

The gist of CFA is that the model indicating the number of factors and items in each factor is determined and tested whether the model fits the available data (Gillaspy, 1996). In other words, it tests whether the assumed relationship(s) is in line with the real data (Goretzko et al., 2023) Given this, the researchers anticipate that since the factorial structure of AILS was already tested in another culture, and it has an underlying theory, it would be adequate to do CFA for the adapted version.

There are lots of fit indices as far as CFA is concerned. Although there are no clear-cut boundaries for what the lowest values for an acceptable fit are, the general tendency is that the standard errors of the parameter estimates are reasonable (Schermelleh-Engel & Moosbrugger, 2003). Taking these into consideration, the results of the CFA analysis are given in Table 2 below.

Table 2:
CFA Indices

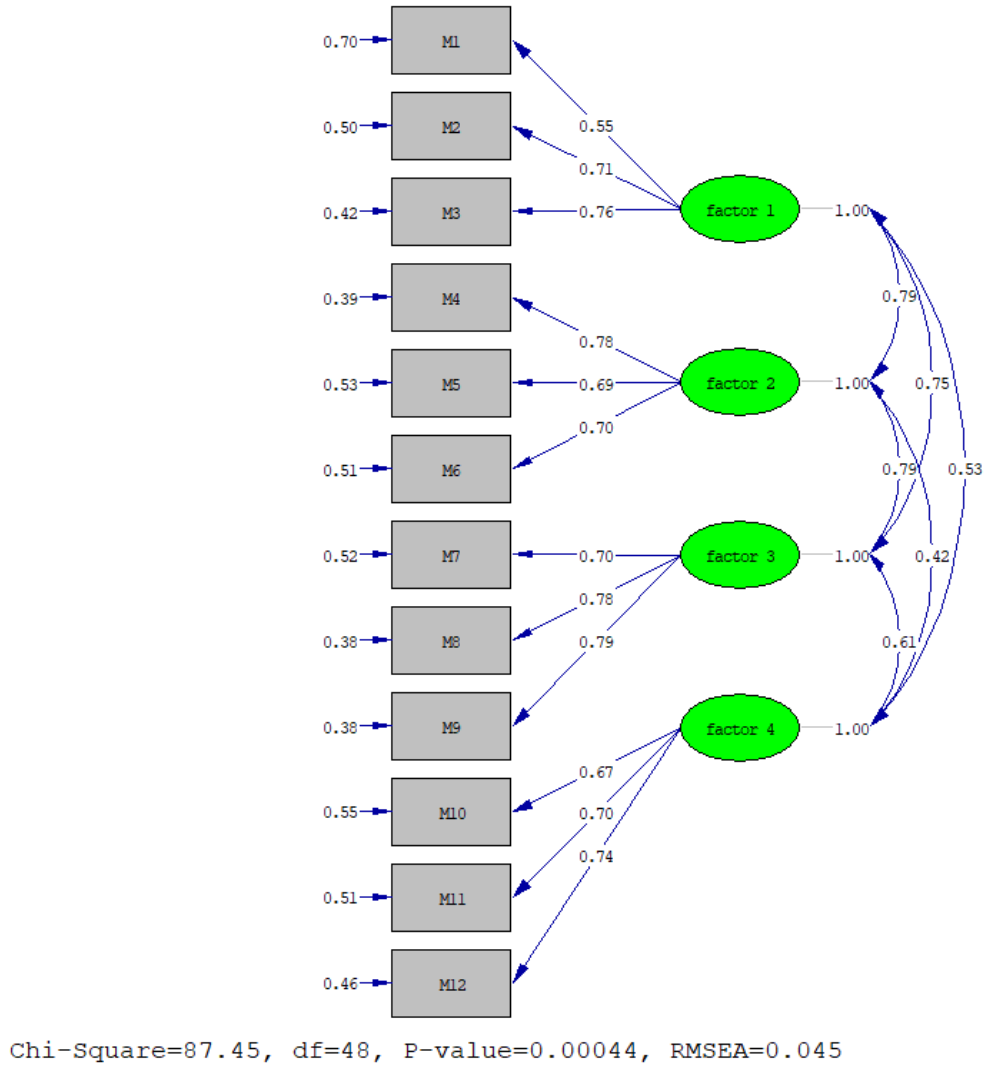
Fit Indices	Good Fit	Outputs
$x^2/sd \leq 3$	$x^2/sd \leq 3$	1.82
RMSEA ≤ 0.05	RMSEA ≤ 0.05	0.04
RMR ≤ 0.05	RMR ≤ 0.05	0.03
NFI ≥ 0.95	NFI ≥ 0.95	0.95
CFI ≥ 0.97	CFI ≥ 0.97	0.98
GFI ≥ 0.90	GFI ≥ 0.90	0.96
AGFI ≥ 0.90	AGFI ≥ 0.90	0.94

Adapted from: (Karagöz & İrge, 2023)

Some researchers state that all goodness-of-fit measures are a function of the chi-square and the degrees of freedom (Hox, 2021). Thus, the X^2/df ratio is regarded as the adequacy criterion of the model (Cihangir Çankaya, 2009; Kalafat, 2012). Browne and Cudeck (1993), and Jöreskog and Sörbom (1993) suggest that RMSEA < 0.05 indicates a close fit (Xia & Yang, 2019). The smaller values of RMSEA and RMR indicate a better fit (Büyüköztürk et al., 2004; Taasoobshirazi & Wang, 2016). NFI and CFI values closer to 1 indicate a better fit. In other words, the larger NFI and CFI values, the better model fit (Elrehail, 2018). Greater values than 0.9 for GFI is an indicator of good fit (Hu & Bentler, 1999; Muenjohn & Armstrong, 2008). AGFI is a measure of the relative amount of variance and covariance explained and values above 0.85

are acceptable. Greater AGFI values indicate a better fit (Pedroso et al., 2016). Taking Table 2 into consideration, and the abovementioned references, the adapted AILS has a good fit. The path analysis of the adapted scale is available in Figure 1 below.

Figure 1:
The Path Analysis



3.1. Reliability

In brief, the reliability is about getting consistent results from a measurement. A reliable measurement tool should be free of errors. There is more than one reliability method in the literature. Cronbach's alpha technique is one of the most frequently used (Thanasegaran, 2009; Amirrudin et al., 2020). The alpha technique is a measure of the internal consistency of a test or scale and ranges between 0-1. The internal consistency is also important for validity (Tavakol

& Dennick, 2011). In other words, a measurement tool cannot be valid if it is not reliable (Amirrudin et al., 2020). There are no clear-cut boundaries on how to interpret alpha, which makes it difficult for some researchers to interpret alpha results. Alpha coefficients between 0.70-0.80 are recommended (Nunally, 1978 as cited in Panayides, 2013).

Table 3:
The reliability results of AILS

Factors	Items	α
Awareness	1, 2, 3	0.72
Usage	4, 5, 6	0.74
Evaluation	7, 8, 9	0.76
Ethic	10, 11, 1	0.72
Total Scale		0.85

Considering Cronbach's alpha outputs for the adapted version of AILS, the results vary between 0.72-0.85, and they are similar to the original ones in the original version. Consequently, it can easily be concluded that the adapted version is also reliable.

4. Discussion and Conclusion

Recently, AI has become widespread in all walks of life, and researchers believe that it will continue to increase its impact. That's why, AI literacy enabling individuals to know, use, evaluate, and ethically utilize AI tools becomes an important matter. On the other side, the literature review revealed that there is no measurement tool aiming to measure the AI literacy levels of individuals in the Turkish language. For that reason, the adapted AILS is expected to contribute to the literature. Taking this into account, the purpose of this research is to adapt the Artificial Intelligence Literacy Scale (AILS), developed by Wang et al. (2022), into Turkish language. The scale aims to measure the AI literacy levels of non-expert adult AI users. Since the adapted version consists of four factors as in the original scale, the researchers called the factors the same as in the original version.

A high score on the scale indicates a high level of artificial intelligence literacy. After the translation, the pilot study was done with 65 participants, however, the actual research data were gathered from 402 participants via Google Forms. CFA and reliability analyses were performed with IBM SPSS Statistics (Version 23.0) and LISREL 8.80 (Jöreskog & Sörbom, 2019). The results indicate that the scale is a good fit. In the reliability analysis, Cronbach's Alpha coefficient varies between 0.72 and 0.76 for the factors, and it is 0.85 for the whole scale.

Wang et al. (2022) associated AI literacy with digital literacy (DL) and information and communication technology (ICT) literacy. In other words, they took these different literacy types into account while developing AILS. They utilized some common models, such as technological, cognitive and ethical, in various digital literacy definitions (Eshet, 2004; Gapski, 2007; Calvani et al., 2008; Calvani et al., 2009; Ferrari, 2012; Balfe et al., 2018) and the KSAVE model proposed by Wilson et al. (2015) for ICT consisting of knowledge (K), skills (S), attitudes (A), values (V), and ethics (E). Based on these models, Wang et al. (2022) define AI literacy as the ability to be aware of and comprehend AI technology in practical applications.

This research has some limitations, too, as in every research. For instance, the majority of the participants are bachelors and postgraduates, and they completed the scale over the Internet. In turn, the average AI literacy score of the participants was high. In the following research, the AI literacy levels of individuals can be studied with participants who have lower educational backgrounds, and the relationship between individuals' educational background and digital literacy skills on AI literacy can be revealed.

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6. Appendix

Madde No	YAPAY ZEKÂ OKURYAZARLIĞI ÖLÇEĞİ	Kesinlikle Katılıyorum	Katılıyorum	Kısmen Katılıyorum	Kararsızım	Kısmen Katılmıyorum	Katılmıyorum	Kesinlikle Katılmıyorum
Farkındalık								
1	Akıllı cihazlar ile akıllı olmayan cihazları birbirinden ayırt edebilirim.	1	2	3	4	5	6	7
2	Yapay zekâ teknolojisinin bana nasıl yardımcı olacağını bilmiyorum. T	1	2	3	4	5	6	7
3	Kullandığım uygulama ve ürünlerde kullanılan yapay zekâ teknolojisini tanımlayabilirim.	1	2	3	4	5	6	7
Kullanım								
4	Günlük işlerimde bana yardımcı olması için yapay zekâ uygulamalarını veya ürünlerini ustalıkla kullanabilirim.	1	2	3	4	5	6	7
5	Yeni bir yapay zekâ uygulamasını veya ürününü kullanmayı öğrenmek benim için genellikle zordur. T	1	2	3	4	5	6	7
6	İş verimliliğimi artırmak için yapay zekâ uygulamalarını veya ürünlerini kullanabilirim.	1	2	3	4	5	6	7
Değerlendirme								
7	Bir yapay zekâ uygulamasını veya ürününü bir süre kullandıktan sonra kapasitesini ve sınırlarını değerlendirebilirim.	1	2	3	4	5	6	7
8	Belirli bir görev için çeşitli yapay zekâ uygulamaları veya ürünleri arasından en uygun olanını seçebilirim.	1	2	3	4	5	6	7
9	Yapay zekâ tarafından sunulan çeşitli çözümler arasından uygun olanını seçebilirim.	1	2	3	4	5	6	7
Etik								
10	Yapay zekâ uygulamalarını veya ürünlerini kullanırken her zaman etik ilkelere uyarım.	1	2	3	4	5	6	7
11	Yapay zekâ uygulamalarını veya ürünlerini kullanırken gizlilik ve bilgi güvenliği konularına asla dikkat etmem. T	1	2	3	4	5	6	7
12	Yapay zekâ teknolojisinin kötü amaçlı kullanılmaması için her zaman dikkatliyimdir.	1	2	3	4	5	6	7