Journal for the Education of Gifted Young Scientists, 13(4), 205-225, Dec 2025
e-ISSN: 2149- 360X
jegys.org dergipark.org.tr/jegys

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Research Article

Opinions of pre-service mathematics teachers on digital learning platforms

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Article Info

Received: 1 June 2025
Accepted: 11 October 2025
Online: 30 Dec 2025

Keywords
Digital learning
Digital learning platform
Instructional technologies
Mathematics education
Pre-service mathematics teachers

Abstract

The purpose of this study is to determine pre-service mathematics teachers' views on digital learning platforms, the extent to which these platforms are integrated into teaching and assessment processes, the usability of digital learning platforms in teaching and assessment processes, pre-service mathematics teachers' thoughts on the contributions of digital learning platforms to mathematics education and the problems they encounter when using digital learning platforms. This study is important in terms of helping to determine the necessary strategies and educational policies to support the integration of digital learning platforms into teaching and assessment processes, understanding the potential of digital learning platforms in mathematics teaching and identifying important considerations for improving teaching practices. It also aims to contribute to finding solutions to the problems encountered. In the context of 21st-century skills, including technological skills and digital literacy, it is important to determine pre-service mathematics teachers' knowledge levels about these skills during their professional preparation process and to reveal their opinions about digital learning platforms, which are considered to play a significant role in developing these skills in middle school students. In this research, a case study design, which is one of the qualitative research methods, was used. The study group consists of 68 fourth-year students from the elementary mathematics teaching program at the faculties of education of state universities located in Aydın, Denizli and Kars. Data for the study were collected through a semi-structured interview form consisting of 8 open-ended questions. The data obtained from the data collection process were analyzed using content analysis, a qualitative analysis method. According to the findings of the research, pre-service mathematics teachers prefer the question-and-answer technique the most in teaching. They define digital learning platforms as web-based/online environments and use platforms such as GeoGebra/Desmos and Educational Informatics Network. These pre-service teachers integrate digital learning platforms into teaching and assessment processes and use these platforms because they are engaging and enjoyable. They decide on the platform selection based on the subject and learning outcomes. Additionally, they state that digital platforms are useful in visualizing abstract concepts. However, internet and infrastructure inadequacies are expressed as significant obstacles in the use of digital platforms.

To cite this article:

Çalık, U., and Altıntaş, E. (2025). Opinions of pre-service mathematics teachers on digital learning platforms. *Journal for the Education of Gifted Young Scientists*, *13*(4), 205-225. DOI: http://dx.doi.org/10.17478/jegys.1732142

Introduction

Rapid developments in information technology make it imperative for educators and researchers to keep pace with these technological innovations. As in other fields, the integration of these new technologies into learning and teaching

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processes has become inevitable (Avcı et al., 2019). Digital tools and technologies developed in the 21st century play an important role in education and training processes by facilitating access to information and accelerating communication (Ocak et al., 2024). The rapid increase in digitization has led to significant changes in education and learning methods and has made the use of digital technologies mandatory (Voogt et al., 2013). With the rapid advancement of technology, education and teaching activities have entered a process of transformation and have increasingly taken on a digital character. Social media, web-based platforms, digital games, various applications and virtual learning environments have become an integral part of the education process (Hillman et al., 2020). The widespread use of these tools has enabled rapid progress and transformation in the field of education. The widespread adoption of distance learning, especially during the COVID-19 pandemic, has further increased the role and effectiveness of digital tools (Wang et al., 2020). In addition, the COVID-19 pandemic has accelerated the use of digital education tools, paving the way for digital transformation in education (Hodges et al., 2020). Today, the use of digital education platforms in learning and teaching processes is increasing (Yazıcı, 2021).

Learning with digital tools is used systematically in schools and also plays an effective role in individual learning processes. Today, various digital tools are used for different purposes, and each contributes to specific areas of learning. In this context, the digital tools used in education are highly diverse and can respond quickly and effectively to learners' different learning needs. Furthermore, the use of these tools allows individuals to experience learning that is tailored to their different learning styles and preferences (Ocak et al., 2024). Digital learning environments significantly increase opportunities for individualized education in mathematics by allowing students to learn at their own pace (Koedinger et al., 2012). The use of technology in the teaching process has many positive effects on students (Korkmaz & Yazıcı, 2023). When digital technologies are used appropriately and effectively, they can enrich learning environments and in particular, support students' problem-solving and critical thinking skills (Durmuş & Karakırık, 2006). When technology is used correctly, children's problem-solving skills develop significantly (Astuti et al., 2021).

The abstract nature of mathematics lessons provides a convenient structure to the use of various teaching technologies (Öksüz & Ak, 2010). Different methods such as augmented reality, educational games, STEM, educational robots, flipped learning model, distance learning, web-based learning and realistic mathematics education are teaching technologies used in mathematics education (Korkmaz & Yazıcı, 2023). Technologies used in mathematics education have a significant impact, particularly in making abstract mathematical concepts concrete, solving mathematical problems by relating them to everyday life and teaching topics through appropriate mathematical software (Septian et al., 2020). The effective use of these technologies in the teaching process is directly related not only to the availability of the tools but also to how teachers integrate these tools with pedagogical methods. Teachers' level of knowledge and experience with technology also shapes their attitudes towards these tools (Cüre & Özdener, 2008).

When the literature is examined, there are studies that investigate the attitudes and approaches of mathematics teachers towards the use of technology (Arslan, 2008; Aygün, 2009; Niederhauser & Stoddart, 2001; Seferoğlu, 2001), as well as studies that focus on teachers' experiences and opinions regarding how instructional technologies are applied in mathematics lessons and how they contribute to the teaching process (Bozkurt & Cilavdaroğlu, 2011; Öksüz & Ak, 2010). The literature includes studies on the impact of digital learning platforms on the academic performance of elementary school students (Kliziene et al., 2021), pre-service teachers' attitudes toward teaching and learning mathematics using online platforms (Dilling & Vogler, 2023), graduate students' experiences using digital learning tools (Naidoo, 2020) and teaching with digital platforms and tools (Cirneanu & Moldoveanu, 2024; Dyrvold & Bergvall, 2023; Zwart et al., 2017). Additionally, Polat and Koç (2024) examined science teachers' views on digital learning platforms. Yazıcı (2021) investigated classroom teachers' perceptions of the use of digital education platforms in elementary school mathematics lessons. Akşan Kılıçaslan et al. (2022) revealed how digital platforms and tools used in the online learning process are evaluated by elementary mathematics teachers. While these studies are important for understanding teachers' attitudes toward digital platforms, it is noteworthy that there are a limited number of studies focusing on PMT. This situation highlights the need for more research in this area.

The Century of Türkiye Education Model Teaching Programs Joint Text emphasizes that teachers should integrate digital technologies into teaching, assessment and evaluation processes (Ministry of National Education [MoNE], 2025). Furthermore, digital learning platforms can offer students various opportunities. Digital learning tools can offer various opportunities such as individualized learning (Dilling & Vogler, 2023), learning at one's own pace (Cirneanu & Moldoveanu, 2024) and personalized and differentiated content (Dilling & Vogler, 2023; Fjærestad & Xenofontos 2025). This study is important for determining the views of PMT on digital learning platforms, revealing how they integrate these platforms into mathematics lessons and examining their thoughts on the impact of digital learning platforms on mathematics education. Within the scope of technology skills and digital literacy, which are 21st-century skills, it is important to determine the level of knowledge of pre-service teachers regarding these skills during their preparation for the profession and to reveal their views on digital learning platforms, which are considered to have an important place in the development of these skills in middle school students. Therefore, this study is important in terms of understanding the potential of digital learning platforms in mathematics education, determining the necessary strategies and educational policies to support opinions of elementary mathematics teacher and PMT in integrating digital learning platforms into their teaching and assessment processes and contributing to the solutions of the problems encountered.

The purpose of this study is to determine the views of PMT on digital learning platforms, the extent to which these platforms are integrated into teaching and assessment processes, the usability of digital learning platforms in teaching and assessment processes, the thoughts of PMT on the contributions of digital learning platforms to mathematics education and the problems they encounter when using digital learning platforms.

The main problem of this study is "What are the views of PMT on digital learning platforms?"
In line with the research problem, the study sought answers to the following sub-problems.

- What methods and techniques do PMT prefer in teaching?
- What is the knowledge of PMT about digital learning platforms?"
- What digital learning platforms do PMT use?
- How do PMT integrate digital learning platforms into their lessons?
- What are the views of PMT regarding the usability of digital learning platforms in the teaching and assessment process?
- What criteria do PMT pay attention to when selecting digital learning platforms for use in the teaching process?
- What are the views of PMT on the impact of digital learning platforms on mathematics education?
- What problems do PMT encounter when using digital learning platforms?"

Method

This section of the study provides information about the research design, study group, data collection instruments, and data analysis.

Research Design

Since the study examined the views of PMT on digital learning platforms, as well as their perceptions of the platforms' usability in teaching and assessment processes and their contributions to mathematics education, the case study method, one of the qualitative research methods, was employed. A case study is defined as a study in which the researcher examines an event in depth based on the questions of why and how (Yıldırım & Şimşek, 2011) and as a process of addressing the event under examination in detail within its own natural context and researching it comprehensively (Yin, 2014). Although case studies are defined in different ways in the literature, the common point that all definitions intersect is to examine and explain a situation in detail. In addition, case studies allow for the detailed examination of a complex phenomenon in its natural environment and the systematic monitoring of its changes over time (Subaşı & Okumuş, 2017).

Study Group

The study group of the research consists of 68 fourth-year PMT enrolled in the spring semester of the 2024-2025 academic year in the elementary mathematics teacher education programs at the Faculties of Education of Adnan Menderes University, Kafkas University and Pamukkale University. Since the study was conducted with PMT who were accessible and based on voluntary participation, convenience sampling was used. Convenience sampling is the process of forming a sample starting with the most easily accessible participants in order to reach the target group (Büyüköztürk et al., 2016). Appropriate sampling was preferred because individuals who could devote sufficient time to the research and were willing to explain their views on digital learning platforms in depth were selected from among PMT. Thanks to this method, the views of PMT were examined in detail and detailed data was collected on the target audience of the research. Information regarding the gender of the study group is provided in Table 1.

Table 1. Gender distribution of participants

Gender	f	%
Female	40	58,8
Male	28	41,2

As shown in Table 1, 58.8% of the PMT participating in the study were female, while 41.2% were male.

Data Collection Instruments

In the scope of the research, the questions in the semi-structured interview form titled 'Views of Science Teachers on Digital Learning Platforms' developed by Polat and Koç (2024) were revised with necessary adjustments. In accordance with expert opinions, the expressions of the 2nd and 3rd questions were made clearer and more understandable. To encourage PMT to explain their answers in more detail, phrases such as ' Please explain.' were added to the questions, thus enriching the data set. Furthermore, questions 2. and 3. in the semi-structured interview form were broken down into subheadings to provide more detail. These adjustments increased the academic standard of the data collection tool and expanded the scope and depth of the data set to be collected within the research. Expert opinion was then sought again, and the final version of the semi-structured interview form was given and applied to the study group. The questions included in the data collection tool are listed below:

Q1. Which methods and techniques do you prefer to use when teaching during a 40-minute lesson? Please explain.

Q2.a. How would you define the concept of a digital learning platform? Please explain.

Q2.b. Can you give examples of digital learning platforms that you know?

Q3.a. Do you integrate digital learning platforms into your teaching and assessment processes? Explain why.

Q3.b. Can you explain your reasons and methods for using or not using these platforms? Please explain your reasoning.

Q4. What criteria do you use when deciding which digital learning platform to use in teaching processes? Please explain your reasoning.

Q5. How do you assess the impact of digital learning platforms on mathematics education? Please explain.

Q6. What are the main problems you encounter when using digital learning platforms? Please explain.

The data for the research was collected during the spring semester of the 2024-2025 academic year. During the research process, PMT were given 20 minutes to collect the data.

Data Analysis

The data collected through the semi-structured interview form in the study were analyzed using the content analysis method, one of the qualitative data analysis methods. Using the content analysis method, the views of PMT on digital learning platforms were presented in a clear, understandable and detailed manner and categories and codes were created based on the answers given to the questions. By creating categories and codes, the views of PMT on digital learning platforms were examined in depth and thus common points were coded, conceptualized and interpreted (Yıldırım & Şimşek, 2018).

In the content analysis, the "double coding" method developed by Krippendorff (2018) was used to ensure that the data was examined in a systematic and reliable manner. In this process, each participant's response was coded separately by at least two independent researchers and the consistency between the codings was checked. This method was chosen to increase reliability in the coding process and to ensure that the data were analyzed more objectively. Accordingly, the responses of PMT to the semi-structured interview form were carefully examined and preliminary coding was performed. Similar codes obtained were grouped together to form categories. Thus, the views of PMT were systematically analyzed and presented in a comprehensive manner (Creswell, 2013; Krippendorff, 2018). In addition, in order to reflect the thoughts of PMT regarding digital learning platforms more clearly and directly, sample quotations were also included in the data analysis process. To ensure the validity and reliability of the coding process, the opinions of field experts were consulted and expert evaluations were obtained regarding the categories reached through the coding. The categories and codes were revised and finalized based on the feedback obtained from the expert opinions (Yıldırım & Şimşek, 2018). Thanks to the data analysis process, the views of PMT on digital learning platforms were evaluated in detail.

In the study, Krippendorff's Alpha (α) coefficient was calculated to assess the reliability of the coding process. In this regard, the observed dissimilarity was found to be 0.193, while the expected dissimilarity was 0.741 and accordingly, the Alpha coefficient was calculated to be approximately 0.739. This value indicates a meaningful consistency among the coders. In this context, the value of 0.739 falls within the reliability limits accepted in qualitative data analysis and supports the consistency between codings. This ensures the reliability of the research (Baltacı, 2017).

Findings

This section of the study presents tables analyzing the views of o PMT on digital learning platforms, along with examples of frequently encountered categories, codes and noteworthy findings. The study's findings are presented under eight main headings.

Methods and Techniques Preferred by PMT in Teaching Lessons

Table 2. Preferred strategy, method and technique

Category	Code	f	%	PMT
Method	Narration (Plain Narration)	19	12.18	2, 4, 8, 10, 13, 18, 19, 30, 32, 38, 40, 41 45, 47, 49, 54, 62, 66, 67
	Discussion	17	10.90	6, 7, 13, 18, 19, 23, 32, 33, 38, 39, 41, 42, 47, 49, 56, 62, 66
	Problem Solving	9	5.77	3, 6, 7, 11, 19, 27, 39, 49, 66
	Demonstration and Practice	6	3.85	23, 28, 29, 39, 45, 63
	Project-Based Learning	1	0.64	3
	Reasoning	1	0.64	8
Technical	Question-Answer	33	21.15	2, 3, 5, 6, 7, 8, 10, 11, 13, 18, 19, 23, 31, 32, 33, 35, 36, 37, 38, 39, 40, 41, 42, 44, 45, 47, 55, 56, 57, 58, 61, 63, 67
	Brainstorming	7	4.49	2, 3, 20, 22, 23, 39, 41
	Role Play	2	1.28	6, 20
Strategy	Discovery Method	22	14.10	1, 2, 3, 9, 10, 12, 14, 15, 16, 17, 22, 25, 28, 29, 41, 46, 48, 50, 59, 60, 61, 64
	Presentation Method	21	13.46	1, 2, 3, 10, 17, 20, 22, 28, 29, 43, 45, 46, 48, 50, 53, 55, 57, 59, 60, 61, 64
	Collaborative Learning	18	11.54	1, 2, 3, 4, 10, 11, 14, 17, 20, 22, 26, 30, 32, 36, 40, 47, 62, 68

As shown in Table 2, the responses of PMT to the question "Which methods and techniques do you prefer to use when teaching a 40-minute lesson?" have been grouped under 3 categories and 12 codes. It was concluded that the most frequently preferred method category in the lesson presentations of PMT was narration (12.18%), the most frequently preferred technique category was question-answer (21.15%) and the most frequently preferred strategy category was discovery method (14.10%). The least frequently preferred method category in the lesson presentations of PMT was project-based learning (0.64%) and reasoning (0.64%), the least frequently preferred technique category was role-playing (1.28%) and the least frequently preferred strategy category was collaborative learning (11.54%).

PMT preferred, respectively after the lecture method, the discussion (10.90%), problem-solving (5.77%), and demonstration–practice (3.85%) methods. The least preferred methods are project-based learning (0.64%) and reasoning (0.64%). After the question-and-answer technique, PMT preferred brainstorming (4.49%) and role-playing (1.28%) techniques. After the discovery method, PMT preferred the presentation method (13.46%) and cooperative learning (11.54%) strategies. It is seen that PMT preferred the codes under the strategy category in similar proportions. Examples of responses from PMT are provided below:

PMT2: *"While striving to apply methods based on discovery learning, lessons are conducted using techniques such as collaborative learning, discovery learning, presentation-based learning, question-and-answer sessions, narration and brainstorming."*

PMT3: *"Discovery learning, presentation-based learning, collaborative learning, project-based learning, question-and-answer, brainstorming, problem-solving techniques."*

PMT6: *"Discussion method, problem-solving method, question-and-answer, role-playing."*

PMT36: *"In teaching lessons, I generally use the direct teaching method along with question-and-answer and collaborative learning techniques. I frequently conduct interactive activities and group work to encourage students' active participation in the lesson. I also use digital tools to make the topics more concrete and understandable."*

PMT45: *"In a 40-minute lesson, I generally prefer methods and techniques such as presentation, question-and-answer technique and demonstration."*

PMT62: *"Presentation, straightforward explanation, discussion, collaborative learning."*

Knowledge of PMT on Digital Learning Platforms

Table 3. Definition of the Concept of Digital Learning Platform

Category	Code	f	%	PMT
Online Learning Systems	Web-based/online learning environment	20	27.78	1, 2, 3, 8, 9, 10, 33, 35, 36, 38, 41, 42, 43, 45, 46, 47, 52, 54, 65, 67
	Interactive platform	8	11.11	1, 6, 15, 35, 36, 37, 40, 58
	Application/website for active learning	1	1.39	17
Digital Learning Materials and Content	Materials supporting learning and teaching	4	5.56	4, 19, 25, 32
	Materials for concretization/modeling	3	4.17	21, 32, 48,
	Applications with instructional and educational content	2	2.78	59, 62
	MoNE digital content network (public/institutional resources)	1	1.39	66
Learning Support with Digital Applications	Applications facilitating teaching (supporting tools)	6	8.33	25, 51, 52, 53, 55, 63
	Learning reinforcement applications	2	2.78	14, 45
Digital Teaching and Educational Technologies	Technology-supported teaching tools	11	15.28	7, 11, 16, 18, 20, 26, 27, 28, 30, 43, 49
	Virtual teaching environment	2	2.78	5, 60
	Applications for tracking the teaching process	1	1.39	41
Flexible and Personalized Learning Environment	Time-space independent learning tools	7	9.72	9, 12, 22, 24, 34, 40, 65
	Personalized learning environment	3	4.17	22, 57, 68
	Synchronous/asynchronous learning system	1	1.39	68

As shown in Table 3, the responses of PMT to the question "How would you define the concept of a digital learning platform? Please explain" were grouped under 5 categories and 15 codes. The vast majority of PMT (27.78%) described the digital learning platform as a web-based/online learning environment. In addition, also defined they as a technology-supported teaching tool (15.28%), an interactive platform (11.11%), a time- space independent learning tool (9.72%) and an applications facilitating teaching (supporting tools) (8.33%). They gave at least these answers: PMT defined digital learning platforms as a synchronous/asynchronous learning system (1.39%), a MoNE digital content network (public/institutional resource) (1.39%), an application for tracking the teaching process (1.39%) and an application/website where active learning takes place (1.39%). Examples of responses from PMT are provided below:

PMT1: "They are online systems that enable individuals to access information, learn and interact with content through the internet or digital devices."
PMT2: "I can say that a digital learning platform is a platform that facilitates learning and teaching, where lesson content that can be accessed online is integrated with technology to achieve the targeted outcomes."
PMT5: "A digital learning program is the computer- or virtual-environment-based implementation of teaching."
PMT6: "These are online resources that contain learning, activities, and content in a specific field and enable interactive work."
PMT58: "Digital learning platforms are online environments that enable educational processes such as accessing information, learning, assessment and content sharing via the internet."
PMT59: "A platform that hosts educational and instructional content and provides access to this content for a fee."
PMT67: "Education provided via the web."

Digital Learning Platforms Used by PMT

Table 4. Examples of Digital Learning Platforms

Category	Code	f	%	PMT
International and Open Access Education Platforms	Khan Academy	18	7.47	6, 7, 9, 10, 11, 33, 35, 41, 42, 46, 47, 55, 56, 59, 62, 63, 65, 67
	Udemy	9	3.73	1, 3, 9, 10, 11, 12, 15, 33, 42
	YouTube	8	3.32	9, 11, 12, 53, 61, 65, 67, 68
	Edx	4	1.66	1, 3, 11, 33
	Coursera	4	1.66	1, 3, 11, 33
	PhET	4	1.66	6, 19, 20, 21
Public Education Platforms	EIN (Educational Informatics Network)	39	16.18	2, 3, 4, 8, 10, 14, 15, 16, 17, 33, 35, 36, 37, 38, 40, 41, 42, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 56, 57, 58, 60, 61, 62, 63, 64, 65, 66, 67, 68
	MNEI (Ministry of National Education Informatics)	3	1.24	4, 8, 14
Mathematics and Academic-Based Platforms	GeoGebra/Desmos	40	16.60	5, 6, 7, 9, 10, 11, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 41, 43, 45, 48, 50, 51, 52, 54, 55, 58, 60, 61, 62, 63, 64, 66, 67, 68
	Mathigon	18	7.47	18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 29, 30, 31, 32, 41, 61, 62, 63
	Sketchpad	6	2.49	7, 19, 20, 21, 22, 23
	Scratch	6	2.49	22, 23, 27, 28, 50, 52
	Toy Theater	4	1.66	19, 28, 29, 32
	Polypad	4	1.66	6, 7, 54, 55
	Codap	2	0.83	19, 32
	Mathletics	1	0.41	7
	Geoboard	1	0.41	19
Language Learning Platforms	Dualingo	4	1.66	2, 3, 35, 46
	Cambly	1	0.41	2
Online Classroom Management	Google Classroom	8	3.32	10, 18, 35, 36, 37, 40, 41, 49
	Zoom	6	2.49	36, 37, 40, 49, 53, 58,
	Microsoft Teams	5	2.07	36, 37, 40, 49, 60
	ADÜZEM (Aydın University Digital Education Center)	3	1.24	1, 2, 15

Private (Commercial) Education Platforms	Doping Hafıza	12	4.98	3, 13, 34, 38, 39, 42, 50, 59, 61, 63, 65, 68
	Morpa Kampüs	8	3.32	16, 38, 39, 47, 57, 60, 61, 65
	Vitamin	1	0.41	39
Interactive and Game-Based Platforms	Wordwall	16	6.64	18, 21, 23, 32, 48, 50, 51, 52, 54, 55, 56, 57, 60, 61, 63, 64
	Kahoot	4	1.66	16, 35, 37, 63
	Quizizz	1	0.41	35
	Padlet	1	0.41	18

As shown in Table 4, the responses of PMT to the question "Can you give examples of digital learning platforms?" were grouped under 7 categories and 30 codes. It was determined that the most well-known digital learning platform among PMT was GeoGebra/Desmos (16.60%) under the "Mathematics and Academic-Based Platforms" category. The most frequently mentioned digital learning platforms by PMT were Khan Academy (7.47%) under the category of "International and Open Source Access Education Platforms," EIN (16.18%) under the "Public Education Platforms" category, Duolingo (1.66%) under the "Language Learning Platforms" category, Google Classroom (3.32%) under the "Online Classroom Management" category, Doping Hafıza (4.98%) under the "Commercial (Commercial) Education Platforms" category, Doping Hafıza (4.98%) and under the "Interactive and Game-Based Platforms" category, Wordwall (6.64%). The digital learning platforms least mentioned by PMT are Mathletics (0.41%), Geoboard (0.41%), Cambly (0.41%), Vitamin (0.41%), Quizizz (0.41%) and Padlet (0.41%).

PMT mentioned Udemy (3.73%), YouTube (3.32%), Edx (1.66%), Coursera (1.66%) and PhET (1.66%) in the "International and Open Access Education Platforms" category. In the Public Education Platforms category, EIN (16.18%) is followed by MNEI (1.24%). Among Mathematics and Academic-Based Platforms, pre-service teachers mentioned Mathigon (7.47%), Sketchpad (2.49%), Scratch (2.49%), Toy Theater (1.66%), Polypad (1.66%), Codap (0.83%), Mathletics (0.41%) and Geoboard (0.41%). In the Language Learning Platforms category, Cambly (0.41%) was mentioned. In the Online Classroom Management category, Zoom (2.49%), Microsoft Teams (2.07%) and ADÜZEM (1.24%) were mentioned. Among Private (Commercial) Education Platforms, Morpa Kampüs (3.32%) and Vitamin (0.41%) were mentioned, while among Interactive and Game-Based Platforms, Kahoot (1.66%), Quizizz (0.41%) and Padlet (0.41%) were mentioned.

PMT Integration of Digital Learning Platforms into Teaching and Assessment Processes

Table 5. Digital learning platform usage preferences of PMT

Category	f	%	PMT
Yes	51	75.00	1, 2, 7, 9, 13, 14, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 28, 29, 30, 31, 32, 33, 35, 36, 37, 38, 39, 40, 42, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 66, 68
No	6	8.82	3, 4, 8, 10, 15, 41
Partially	7	10.29	5, 6, 11, 22, 27, 54, 65
No idea	4	5.89	12, 34, 43, 67

As seen in Table 5, the responses of PMT to the question "Do you integrate digital learning platforms into your teaching and assessment processes? Please explain why?" were grouped under four categories. It was concluded that the vast majority of PMT (75.00%) integrated digital learning platforms into their teaching and assessment processes. It was observed that some PMT (8.82%) did not integrate, some (10.29%) partially integrated and a very few (5.89%) had no idea about integrating digital learning platforms into their teaching and assessment processes.

Based on the statements made by the PMT, the codes obtained within the yes, no and partially categories in Table 5 were categorized and examined under the yes and no categories. The codes obtained as a result of this analysis are presented in detail in Table 6.

Table 6. Reasons for integrating or not integrating digital learning platforms into teaching and assessment processes

Category	Code	f	%	PMT
Yes	Attention-grabbing and entertaining	20	28.57	14, 16, 17, 19, 21, 23, 30, 36, 38, 45, 47, 50, 51, 56, 57, 58, 61, 63, 64, 68
	Making abstract concepts more concrete	8	11.43	9, 20, 21, 29, 45, 55, 60, 68
	Providing feedback	5	7.14	33, 36, 37, 40, 58
	Enhancing the efficiency of the learning-teaching process	4	5.71	1, 6, 13, 49
	Using time effectively	3	4.29	5, 38, 65
	Being accessible and affordable	3	4.29	11, 33, 48
	Simplifying teaching	2	2.86	13, 52
	Offering a variety of question types	2	2.86	14, 25
	Promoting dynamic learning	2	2.86	2, 7
	Fostering long-lasting learning	2	2.86	26, 62
	Encouraging meaningful learning	2	2.86	18, 28
	Personalized learning experiences	2	2.86	33, 35
	Rich content	2	2.86	33, 35
	Providing visual aids	2	2.86	48, 53
	Engaging multiple senses	2	2.86	44, 62
	Making teaching easier	1	1.43	31
	Conceptual understanding	1	1.43	32
	Enabling learning independent of time and place	1	1.43	59
	Learning through diverse methods	1	1.43	66
No	Limited use of technological devices	1	1.43	15
	Complicating classroom management	1	1.43	6
	Restricting access to only teachers working at the MoNE	1	1.43	8
	Being costly	1	1.43	41
	Difficult to supervise	1	1.43	41

As seen in Table 6, 24 codes were found based on the responses of PMT to the question "Do you integrate digital learning platforms into teaching and evaluation processes? explain why." Among PMT, the most emphasized reason for integrating digital learning platforms into teaching and assessment processes is that they are attention-grabbing and entertaining (28.57%). Other frequently mentioned reasons include making abstract concepts more concrete (11.43%), providing feedback (7.14%), enhancing the efficiency of the learning-teaching process (5.71%), using time effectively (4.29%), being accessible and affordable (4.29%) and fostering long-lasting learning (2.86%). Additionally, PMTs mentioned reasons less frequently, such as personalized learning experiences (2.86%), rich content (2.86%), providing visual aids (2.86%), conceptual understanding (1.43%), simplifying teaching (1.43%), learning independent of time and place (1.43%) and learning through diverse methods (1.43%).

As for the reasons for not integrating digital learning platforms, PMTs reported limited use of technological devices (1.43%), complicating classroom management (1.43%), restricting access to only teachers working at the MoNE (1.43%), being costly (1.43%) and difficulty in supervision (1.43%). Examples of responses from PMT are provided below:

PMT1: *"I use the EIN platform because the learning process is more efficient."*

PMT2: *"I integrate GeoGebra very effectively. The reason is that it provides great benefits to the dynamic learning of course outcomes."*

PMT4: *"I would like to do so when I become a teacher, but since we currently teach 2 hours a week, I do not make an evaluation in the digital environment."*

PMT36: *"Yes, because times have changed and such platforms attract the attention of students. We have the opportunity to follow students more actively in a short time. It also offers the opportunity to go back and do it immediately."*

PMT38: *"Yes, I am trying to integrate it, it is at the stage of attracting attention and evaluating the subject. Because visual and audio feedback attracts students' attention and enables efficient use of time."*

PMT41: *"No, I think it is not economical. Difficult to supervise and prone to cheating."*

PMT59: *"Yes, it is a great convenience to be able to take courses regardless of time and place, so I adapt to the process with online courses."*

Using of Digital Learning Platforms in Teaching and Assessment Processes by PMT

Table 7. Reasons for Using or Not Benefiting from Digital Learning Platforms

Category	Code	f	%	PMT
Advantages	Attention-grabbing and entertaining	14	15,91	1, 5, 14, 17, 22, 23, 24, 35, 47, 51, 57, 58, 61, 64
	Clear and easy-to-understand instruction	9	10,23	26, 27, 28, 30, 31, 51, 57, 59, 63
	Interactive learning	6	6,82	33, 35, 39, 40, 49, 50
	Using time effectively	6	6,82	5, 12, 38, 53, 63, 65
	Providing visual aids	5	5,68	1, 13, 19, 39, 53,
	Ensuring lasting learning	5	5,68	24, 45, 53, 60, 62
	Making abstract concepts concrete	5	5,68	9, 19, 28, 29, 68
	Actively engaging students	4	4,55	16, 46, 49, 60
	Being economical	2	2,27	11, 48
	Promoting meaningful learning	2	2,27	2, 55
	Encouraging exploration	2	2,27	15, 41
	Personalized learning	2	2,27	33, 35
	Rich content	2	2,27	33, 39
	Providing feedback	2	2,27	33, 58
	Motivating students	2	2,27	23, 68
	Supporting the homework process	1	1,14	3
	Offering real-life examples	1	1,14	4
	Presenting multiple solutions	1	1,14	6
	Grounding the topic	1	1,14	6
	Using when the explanation is insufficient	1	1,14	7
	Providing reinforcement	1	1,14	20
	Adopting a constructivist teaching approach	1	1,14	21
	Helping create mental frameworks	1	1,14	20
	Facilitating conceptual learning	1	1,14	23
	Accessing different types of questions	1	1,14	25
	Enhancing students' confidence and tracking the learning process	1	1,14	14
Disadvantages	Complicating classroom management	2	2,27	30, 62
	Teacher's inadequacy	2	2,27	56, 61
	Technological access and skill inequalities	1	1,14	33
	Concerns about content quality and reliability	1	1,14	33
	Attention distractions and lack of motivation	1	1,14	33
	Time constraints	1	1,14	54
	Not feeling the need to use it	1	1,14	10

As seen in Table 7, the responses of PMT to the question "Could you explain your reasons and methods for using or not using these platforms? Explain why", were grouped into 2 categories and 33 codes. PMT most frequently stated that the reason for using digital learning platforms is that they are attention-grabbing and entertaining (15.91%). PMT can use digital learning platforms; They stated that they frequently use it for reasons such as providing understandable and easy education (10.23%) and providing interactive learning opportunities (6.82%). In addition, pre-service teachers stated that they benefit from the platforms' features of using time effectively (6.82%) and providing visual aid (5.68%).

PMT stated that they did not benefit from digital learning platforms mostly due to the difficulties in classroom management (2.27%) and the inadequacy of the teacher (2.27%). On the other hand, PMT mentioned reasons such as technological access and skill inequality (1.14%), content quality and reliability problems (1.14%), distraction and lack of motivation (1.14%), time constraints (1.14%) and not needing to use it (1.14%). Examples of responses from PMT are provided below:

PMT1: *"It attracts the attention of students. It is visually richer."*
PMT10: *"I have never used it or benefited from it because I did not need it until now, but I would like to use it when the educational environment becomes difficult and I turn to virtual."*
PMT13: *"I benefit from it. It is easily accessible and supports teaching with visual teaching."*
PMT33: *"Reasons for using it: Access to broad and up-to-date information, a variety of teaching materials, a sense of presentation, offering a personalized learning experience, encouraging interaction and collaboration, accessibility and flexibility."*
My reasons for not benefiting from it: Technological development and inequality of skills, the importance of face-face interaction, the problem of content quality and reliability, distraction and motivation problems."
PMT58: *"The biggest reason for using it is that it increases students' interest in the course and makes learning fun. It also facilitates communication and follow-up during the distance education process. As a method, I choose the appropriate platform according to the nature of the subject and plan the event."*
PMT61: *"The reason I don't use it is that I am inadequate on digital platforms."*

Criteria Considered by PMT When Choosing the Digital Learning Platform to be Used in the Teaching Process

Table 8. Criteria considered when choosing the digital learning platform used in teaching processes

Category	Code	f	%	PMT
Teaching, Content and Topic Relationship	Based on topic/outcome/learning objectives	15	13.89	2, 17, 19, 21, 24, 27, 28, 30, 32, 42, 47, 53, 56, 62, 66
	The possibility of conducting teaching	5	4.63	15, 23, 39, 43, 55
	According to the intended use	4	3.70	4, 6, 50, 68
	According to the relationship between the topic and the platform	4	3.70	19, 22, 32, 55
	Content richness	2	1.85	51, 58
	Real-life examples	2	1.85	38, 44
	Based on the abstract nature of the topic	1	0.93	29
Usability, Accessibility and Competence	Being user-friendly	15	13.89	10, 12, 28, 31, 33, 34, 35, 45, 46, 49, 54, 58, 62, 63, 68
	Efficient use of time	4	3.70	6, 7, 34, 61
	Free/affordable	4	3.70	14, 41, 63, 68
	Reliability	4	3.70	14, 39, 58, 59
	Efficiency of the learning process	3	2.78	1, 16, 18
	Easy accessibility	2	1.85	13, 59
	Support for the Turkish language	2	1.85	51, 60
	Simplicity	2	1.85	59, 62
	International competence	1	0.93	11
	Gamifiable application	1	0.93	52
	Objectivity	1	0.93	65
	Containing next-generation questions	1	0.93	67
Student-Centeredness	Based on the student's level (class level and readiness)	13	12.04	3, 5, 8, 20, 21, 28, 30, 38, 40, 45, 56, 57, 66
	Attention-grabbing and entertaining	8	7.41	7, 8, 13, 23, 47, 57, 61, 64
	Interactive content	3	2.78	35, 39, 64
	Based on the student's needs	2	1.85	3, 25
	Supporting personalized teaching	1	0.93	33
	Allowing the student to learn at their own pace	1	0.93	10
Teacher-Centeredness	Based on the teacher's knowledge and experience	4	3.70	18, 26, 48, 61
	Allowing the teacher to monitor progress	3	2.78	10, 39, 58

As seen in Table 8, PMT answered the question "Based on what criteria do you decide on the digital learning platform to be used in teaching processes? Explain why." The answers to the question were collected under 4 categories and 27 codes. The criteria that PMT pay most attention to when choosing a digital learning platform are; subject, achievement and learning outcomes (13.89%) under the category of teaching content and subject relationship and usability (13.89%) under the category of usability, accessibility and competence. Under the student focus category, the most frequently expressed criterion was based on student level (grade level and readiness) (12.04%) and under the teacher focus category, the most stated criterion was based on the teacher's knowledge and experience (3.70%).

Other factors affecting the preferences of PMT are; purpose of use (3.70%), using time efficiently (3.70%), being free/economical (3.70%), being reliable (3.70%) and the relationship between the subject and the platform (3.70%). In addition, PMT stated that they preferred the platforms for reasons such as providing interactive content (2.78%), supporting personalized teaching (0.93%) and allowing the student to learn at their own pace (0.93%). Examples of responses from PMT are provided below:

PMT10: *"It is useful, it allows the student to learn at his own pace and the teacher can follow the course process."*
PMT11: *"I pay attention to how much of an international voice it has."*
PMT14: *"The reason I chose EIN is that it belongs to the Ministry of Education. One of the selection criteria is that it is free. One of the reasons is easy access."*
PMT33: *"I make decisions based on criteria such as ease of use and accessibility, personalization, support for teaching and evaluation processes."*
PMT48: *"Having a smart board means my ability to use the platform."*
PMT51: *"It has Turkish language support, has a lot of content in terms of variety and has games."*
PMT52: *"There must be an application that I can gamify."*
PMT62: *"The platform is easy to use, the interface is simple and the material is suitable for learning."*

Views of PMT on the ımpact of digital learning platforms on mathematics education

Table 9. The effects of digital learning platforms on mathematics education

Category	Code	f	%	PMT
Contributions to Learning	Making abstract concepts concrete	21	28.00	15, 18, 19, 20, 22, 24, 31, 33, 35, 39, 40, 45, 46, 48, 53, 55, 56, 58, 60, 62, 68
	Ensuring lasting and meaningful learning	8	10.67	11, 12, 29, 32, 40, 44, 57, 62
	Facilitating understanding	4	5.33	6, 38, 51, 63
	Effective learning	3	4.00	19, 64, 66
	Developing concrete thinking	1	1.33	21
	Conceptual learning	1	1.33	23
	Enabling mental visualization	1	1.33	23
Contributions to the Student	Increasing student motivation and interest	15	20.00	5, 7, 13, 14, 16, 17, 35, 40, 47, 48, 49, 50, 60, 61, 64
	Being interactive	2	2.67	6, 33
	Increasing the learning speed	1	1.33	8
	Personalized learning	1	1.33	33
	Considering individual differences	1	1.33	56
	Reducing student biases	1	1.33	66
Contributions to Materials and Methods	Providing visual materials	7	9.33	11, 15, 35, 38, 39, 58, 67
	Engaging different senses	1	1.33	6
	Relating mathematics to different disciplines	1	1.33	6
	Providing teaching with various options	1	1.33	13
	Relating to real-life situations	1	1.33	62
Contributions to Time and Accessibility	Using time effectively	2	2.67	49, 61
	Being a space that can expand formal education	1	1.33	7
	Providing education anywhere	1	1.33	41

As shown in Table 9, the responses of PMT to the question "How do you evaluate the effects of digital learning platforms on mathematics education? Please explain." have been grouped under 4 categories and 21 codes. When evaluating the effects of digital learning platforms on mathematics education, PMT most frequently expressed the

following effects: under the contributions to learning category, making abstract concepts concrete (28.0%), under the contributions to the student category, increasing student motivation and interest (20.00%), under the contributions to materials and methods category, providing visual materials (9.33%) and under the contributions to time and accessibility category, using time effectively (2.67%).

In their views on the effects of digital learning platforms on mathematics education, PMT most frequently mentioned the following codes: increasing student motivation and interest (20.00%), lasting and meaningful learning (10.67%), providing visual materials (9.33%) and facilitating understanding (5.33%).

On the other hand, the least mentioned codes in their views on the effects of digital learning platforms on mathematics education were: engaging different senses (1.33%), relating mathematics to different disciplines (1.33%), being a space that can expand formal education (1.33%), increasing the learning speed (1.33%), providing teaching with various options (1.33%), developing concrete thinking (1.33%), facilitating conceptual learning (1.33%), enabling mental visualization (1.33%), providing personalized learning (1.33%), providing education anywhere (1.33%), considering individual differences (1.33%), relating to real-life situations (1.33%) and reducing student biases (1.33%). Examples of responses from PMT are provided below:

> **PMT6:** *"It helps to associate mathematics with different fields and concepts in mathematics education because it is interactive, appeals to different senses, provides understanding, symbolic criticism and brings it to an understandable level."*
> **PMT7:** *"I accept that digitalization is reflected in every field and the focus time of students has decreased; I see it as an area that will attract the attention of students and expand formal education."*
> **PMT45:** *"Since mathematics is a more abstract lesson, I think digital learning platforms are useful for concretization."*
> **PMT46:** "*Students both love mathematics, which is an abstract lesson and learn it better by concretizing it, thanks to these platforms."*
> **PMT49:** *"It helps me save time. It allows students to learn in a more fun and practical way."*
> **PMT60:** *"Effective use of technology in concretizing abstract subjects is very effective in attracting students' attention. I find it useful."*
> **PMT61:** *"It is quite important. Using digital platforms provides efficiency in terms of time during the lesson. Attracting attention provides more effective expression."*
> **PMT62:** *"Concretizing an abstract lesson such as mathematics enables it to be associated with daily life and supports meaningful learning.*
> **PMT68:** "In terms of concretizing the lesson, it captures students' full attention in a subject like mathematics, which is often perceived as intimidating and increases their achievement."

Issues PMT Encounter While Using Digital Learning Platforms

Table 10. Main ıssues encountered while using digital learning platforms

Category	Code	f	%	PMT
Infrastructure and Access-Related Issues	Internet and infrastructure issues/insufficiency	38	36.19	9, 11, 12, 13, 14, 16, 18, 19, 23, 24, 29, 31, 32, 34, 35, 38, 39, 40, 41, 45, 46, 48, 49, 50, 52, 53, 55, 56, 57, 58, 59, 61, 62, 64, 65, 66, 67, 68
	Limited access for students outside of school / material shortage	8	7.62	4, 33, 35, 40, 47, 60, 65, 68
	Faulty smartboards	2	1.90	13, 64
	Inability for every student to use the platform	2	1.90	19, 25
Teacher-Related Issues	Classroom management difficulties	8	7.62	6, 13, 15, 21, 28, 30, 41, 62
	Difficulty mastering digital learning platforms / difficulty learning how to use the platform	6	5.71	5, 7, 18, 22, 24, 26
	Difficulty using technological devices	3	2.86	16, 26, 54
	Difficulty integrating with class level and subject	2	1.90	7, 22
	Time management issues	2	1.90	6, 28
	Inability to accustom students to digital learning	1	0.95	30
	Prejudice against digital platforms	1	0.95	68
Student-Related Issues	Short attention span / attention distraction	7	6.67	15, 29, 35, 39, 40, 53, 59
	Students viewing it as entertainment	4	3.81	7, 50, 51, 52
	Students having difficulty using it	3	2.86	20, 47, 54
	Lack of digital literacy / insufficient skills	2	1.90	56, 58
	Students not having previous exposure	1	0.95	27
	Students not participating	1	0.95	13
Platform-Related Issues	Complexity of platforms (lack of clarity)	7	6.67	11, 14, 23, 31, 39, 40, 44
	Lack of Turkish language support	3	2.86	9, 23, 60
	Content on platforms not fully reflecting the topic/learning outcomes	1	0.95	32
	Trustworthiness issues	1	0.95	33
	Platform insufficiency	1	0.95	56
	Complexity of platforms (lack of clarity)	1	0.95	63

As shown in Table 10, the responses of PMT to the question "What are the main issues you encounter while using digital learning platforms? Please explain." have been grouped under 4 categories and 23 codes. When evaluating the issues they face while using digital learning platforms, PMT most frequently mentioned internet and infrastructure issues/insufficiency (36.19%) under the infrastructure and access-related issues category as the most significant issue. Additionally, PMT mentioned classroom management difficulties (7.62%) under the teacher-related issues category, short student attention span/attention distraction (6.67%) under the student-related issues category and platform complexity (lack of clarity) (6.67%) under the platform-related issues category.

When Table 10 is examined, it can be seen that under the infrastructure and access-related issues category, PMT highlighted issues such as faulty smartboards (1.90%), inability for all students to access platforms (1.90%) and limited access to digital materials outside of school (7.62%). In the teacher-related issues category, they mentioned issues such as difficulty in using technological tools (2.86%), inability to accustom students to digital learning (0.95%), difficulty integrating with class level and subject (1.90%), time management issues (1.90%) and prejudice against digital platforms (0.95%). Under the student-related issues category, the problems expressed were short attention span/attention distraction (6.67%), difficulty using the platform (2.86%), students viewing it as entertainment (3.81%), students having no prior experience (0.95%) and lack of digital literacy/insufficient skills (1.90%). Under the category of platform-related

issues, the reasons mentioned include the lack of Turkish language support (2.86%), content on the platform not fully reflecting the topic/ learning outcomes (0.95%), trustworthiness issues (0.95%), platform insufficiency (0.95%) and complexity of platforms (lack of clarity) (0.95%). Examples of responses from PMT are provided below:

PMT4: *"Student access may be an issue because some students may not have a phone or similar devices. They may not have the necessary resources."*
PMT5: *"I face problems while using digital learning platforms because there are some platforms I am not fully proficient with."*
PMT18: *"Internet problems or lack of information about the platform."*
PMT20: *"Students have difficulties while using it."*
PMT21: *"I would say classroom control and students talking among themselves."*
PMT22: *"I am facing difficulties in applying it in class. This is not due to the platform, but to my professional knowledge."*
PMT32: *"Internet problems during activities, sometimes the internet settings of smartboards cause issues. Similarly, problems with smartboards sometimes result in the digital learning platform's insufficiency. The platform offers activities to cover the topic, but they may not be fully effective."*
PMT40: *"The most frequent problems are internet access issues, lack of technological equipment for students and the complex structure of some platforms. Additionally, some students may experience attention distraction in digital environments."*
PMT66: *"Internet. Situations where the internet is bad and insufficient. Power outages."*

Conclusion and Discussion

The purpose of this study is to determine the views of PMT on digital learning platforms, the extent to which these platforms are integrated into teaching and assessment processes, the usability of digital learning platforms in teaching and assessment processes, the thoughts of PMT on the contributions of digital learning platforms to mathematics education and the problems they encounter when using digital learning platforms. Looking at the results related to the sub-problem "What methods and techniques do PMT prefer in teaching?" it was concluded that PMT prefer the question-answer technique most in their teaching. Furthermore, it was concluded that the majority of PMT used the explanation method, the question-answer technique and the discovery strategy in their lessons. As can be seen, PMT show a greater tendency towards traditional teaching methods. This result is consistent with the findings of Özay Köse (2011) and Serin (2008), who concluded that question-and-answer and explanation are frequently used practices. In his study on teaching methods, Demirel (2018) states that discovery learning and the discovery method are important strategies for ensuring students' deep learning. Therefore, it is significant that pre-service teachers prefer the discovery method strategy in their teaching. The study found that PMT gave less emphasis to project-based learning, reasoning methods and role-playing techniques. This finding parallels Özay Köse's (2011) study, which states that pre-service teachers will give less emphasis to the drama method when they become teachers, showing that PMT give less emphasis to role-playing techniques. These findings indicate that some pre-service teachers embrace contemporary teaching approaches to a lesser extent.

Looking at the results related to the sub-problem "What is the knowledge of PMT about digital learning platforms?", the vast majority of PMT (27.78%) define digital learning platforms as "web-based/online learning environments" under the category of online learning systems. This definition is consistent with the findings of Polat and Koç (2024). At the same time, the category that PMT refer to as online learning systems is similar to the internet-based digital technology finding of Akşan Kılıçaslan et al. (2022). Among the least preferred definitions by PMT are "synchronous/asynchronous learning system" (1.39%) and "MoNE digital content network" (1.39%). The fact that PMT refer to the digital learning platform as the "MoNE digital content network" is similar to Yazıcı's (2021) finding that teachers use digital learning platforms because they are state-supported. This result may stem from PMT perceiving the digital learning platform as an official application.

Looking at the results related to the sub-problem "What digital learning platforms do PMT use?", the examples of digital learning platforms mentioned by PMT in Table 4 are similar to those mentioned by Akşan Kılıçaslan et al. (2022), Arslan (2016), Atan and Kocasaraç (2022), Polat and Koç (2024) and Uzundağ (2016). The fact that PMT most frequently cited GeoGebra/Desmos (16.60%) as a digital learning platform may be due to its being a tool specifically designed for mathematics teaching and one that promotes visual learning. This finding is consistent with the studies by Akşan Kılıçaslan et al. (2022), Dilling and Vogler (2023), Huda and Qohar (2021) and Korenova et al. (2024). The findings of the study by Kutluca and Zengin (2011) also indicate that GeoGebra provides visuality and animation. The high rate of EIN (%16.18) platform examples given by PMT is parallel to Yazıcı's (2021) study. Yazıcı (2021) associates teachers' preference for using EIN with the fact that it is a state-supported platform.

Looking at the results related to the sub-problem "How do PMT integrate digital learning platforms into their lessons?", PMT integrate digital learning platforms into their teaching and assessment processes to a large extent (75.00%). Polat and Koç (2024) concluded that science teachers try to integrate digital learning platforms into their teaching and assessment processes. These results show that teachers and pre-service teachers are not prejudiced against digital learning platforms. The fact that some PMT (10.29%) partially integrate digital platforms can be explained by Bozkurt and Cilavdaroğlu's (2011) statement that teachers need to be familiar with technology and increase their knowledge in order to integrate it. Akşan Kılıçaslan et al. (2022) state that professional practices carried out in collaboration with the MoNE should be supported to improve teachers' digital literacy. When examining the reasons why PMT use digital tools to a limited extent, it was concluded that some PMT do not use them because they feel inadequate in this area. Therefore, according to Acosta Marino et al. (2025), teacher training is important for the effective use of digital platforms.

Looking at the results related to the sub-problem "What are the views of PMT regarding the usability of digital learning platforms in the teaching and assessment process?", the majority of PMT evaluate the integration of digital learning platforms into teaching processes positively. Pre-service teachers stated that they integrated digital learning platforms mainly because they are "attention-grabbing/interesting and fun." This finding is consistent with the views of Mendez et al. (2020) that digital platforms make lessons fun and motivating, Polat and Koç's (2024) finding that they make lessons fun and Yazıcı's (2021) finding that the platforms attract attention and interest in the lesson. The most prominent factors among the reasons why pre-service teachers do not integrate digital learning platforms into their lessons are "limited use of technological devices" (1.43%) and "making classroom management difficult" (1.43%). In their study, Polat and Koç (2024) noted that one of the difficulties science teachers encounter when using digital learning tools is that they complicate classroom management.

One of the most important factors determining why PMT use digital learning platforms is that these platforms are "attention-grabbing and fun" (15.22%). This finding indicates that digital tools have features that increase student motivation and enable them to participate more actively in class, as emphasized by Polat and Koç (2024). According to Dilling and Vogler (2023), digital platforms make math classes more fun and motivating, increasing student participation and interest. Factors such as digital learning platforms providing "clear and easy education" (8.70%), "lasting learning" (5.43%) and "meaningful learning" (2.17%) in the teaching and learning process are also among the important reasons why pre-service teachers prefer digital platforms. This reason is consistent with the findings of Akşan Kılıçaslan et al. (2022) and Yazıcı (2021), who stated that digital tools contribute to lasting learning. The finding that PMT use digital platforms to concretize abstract/subject concepts (5.68%) is consistent with the results of studies conducted by Akşan Kılıçaslan et al. (2022), Polat and Koç (2024) and Yazıcı (2021).

PMT also stated that, among the reasons for not utilizing digital learning platforms, the most common was that these platforms make classroom management more difficult. Additionally, PMT cited "inadequate teacher training" (2.27%) as a reason for not using these platforms. This may be due to the insufficient introduction of digital learning tools to pre-service teachers during their undergraduate education. Yazıcı and Özerbaş (2022) also emphasize the need to introduce digital platforms to teachers.

When examining the results related to the sub-problem "What criteria do PMT pay attention to when selecting digital learning platforms for use in the teaching process?", it is observed that PMT prioritize "subject matter", "learning outcomes" and "learning objectives". This result is consistent with the findings of Bozkurt and Cilavdaroğlu (2011) and Polat and Koç (2024) that digital platforms should be compatible with teaching content and appropriate for the curriculum. Furthermore, criteria such as being appropriate for the student level (grade level and readiness) and being user-friendly are also prominent factors that pre-service teachers consider when selecting a platform. Similarly, Polat and Koç (2024) found that science teachers pay attention to the appropriateness of digital learning platforms for the student level and their user-friendliness when selecting them. This finding is in line with the result reported in the study by Akşan Kılıçaslan et al. (2022), in which mathematics teachers stated that they pay attention to ensuring that digital learning platforms are appropriate for students' developmental levels, thereby enabling students to access content suited to their abilities. Studies in the literature also emphasize that digital learning platforms should be appropriate for the content and curriculum (Dilling & Vogler, 2023; Korenova et al., 2024) and interactive (Korenova et al., 2024), similar to the suggestions of PMT.

Among the factors that PMT consider least important when selecting digital platforms are the criteria of students being able to learn at their own pace (0.93%), international validity (0.93%), meaningfulness for students (0.93%) and instructiveness (0.93%). However, it is seen that the criteria considered by pre-service teachers, such as meaningful learning and instructiveness, coincide with the findings of Yazıcı's (2021) research. This shows that pre-service teachers attach some importance to pedagogical values when choosing digital platforms, but these elements do not come to the fore as much as other technical or functional criteria. Dilling and Vogler (2023) emphasize that digital platforms enable monitoring student performance, reinforcing learned topics and providing opportunities for individualized learning. PMT state that digital learning platforms provide opportunities for students to learn at their own pace. The work of Cirneanu and Moldoveanu (2024) also reveals that digital platforms provide content according to individual progress and student needs. Similar to the views of PMT, studies show that digital platforms can offer personalized and differentiated content (Dilling & Vogler, 2023; Fjærestad & Xenofontos, 2025).

Looking at the results related to the sub-problem "What are the views of PMT on the impact of digital learning platforms on mathematics education?", it is seen that the most emphasized aspect in the evaluations of PMT regarding the impact of digital learning platforms on mathematics education is the concretization of abstract concepts. This finding parallels Bozkurt and Cilavdaroğlu's (2011) statement that they benefit from using complex operations and abstract concepts. PMT stated that digital learning platforms support the learning process in terms of increasing student motivation and interest. These findings are parallel to Korenova et al.'s (2024) finding that they facilitate visualization and concretization. As stated in Keskin Yorgancı's (2019) study, digital tools increase student participation in class, engage them more and generally provide students with a more enjoyable learning experience. This also helps increase students' interest in the lessons. Research also shows that digital platforms increase student interest and motivation (Kliziene et al., 2021; Korenova et al., 2024).

The views of PMT on the effects of digital learning platforms on mathematics education include at least: appealing to different senses, relating mathematics to different disciplines, being an area that can expand formal education, increasing learning speed, providing teaching with different options, developing concrete thinking, enabling conceptual learning, enabling mental visualization, offering personalized learning, providing education anywhere, considering individual differences, relating to daily life and reducing student bias. These factors are areas where the flexibility and personalized learning advantages offered by digital platforms can be developed more strongly. Güler's (2018) study also states that digital platforms offer a flexible learning environment.

When examining the results related to the sub-problem "What problems do PMT encounter when using digital learning platforms?", PMT most frequently mention "Internet and infrastructure problems/insufficiency" under the category of infrastructure and access-related problems. This situation is also consistent with the access-related issues reported in Arslan's (2016) study, which examined teachers' views on the mathematics course content in the EIN, as well as with the findings of Polat and Koç (2024) regarding slow internet connections and malfunctioning smart boards.

PMT state that they are not proficient in digital learning platforms and experience difficulties in learning how to use them. The prevalence of these inadequacies is supported by Cüre and Özdener's (2008) study examining teachers' levels of information technology use. Havrilova et al. (2021) emphasize access, infrastructure and usage problems. Factors such as difficulty in using technological tools, inability to accustom students to digital learning, difficulty in integrating them into the class level and subject matter and time management difficulties reflect the short comings of teacher training programs and continuing professional development activities in this area. As Niederhauser and Stoddart (2001) point out, it is not enough for teachers to have technical knowledge; they must also understand the pedagogical use of digital tools in mathematics education. As Niederhauser and Stoddart (2001) point out, it is not sufficient for teachers to possess only technical knowledge; they also need in-depth knowledge and experience regarding how digital tools can be pedagogically integrated into mathematics teaching. Acosta Marino et al. (2025) emphasize that technical infrastructure and teacher training are important for the effective use of digital platforms.

Recommendations

Based on the research findings and results, the following recommendations are made.

- It is recommended that this study conducted with PMT is also carried out with mathematics teachers and that the resulting findings are compared to see whether they are similar.
- It is recommended to conduct a study comparing the digital literacy and technology literacy skills of mathematics teachers and PMT, as well as their level of integrating digital learning platforms into mathematics lessons.
- It is recommended to conduct studies that can compare the attitudes of mathematics teachers and PMT toward digital learning platforms in terms of various variables such as age, gender, educational background, digital skills and 21st-century skills.
- Studies could be conducted to examine the contribution of technology integration in lesson plans designed by PMT to students' digital learning skills.
- It is recommended to conduct a study focusing on students' opinions regarding the use of digital learning platforms in lessons. Within the scope of this study, comprehensive data can be collected on the effectiveness of the platforms, their contribution to students' learning processes and the challenges encountered. In light of these data, studies can be carried out on the contribution of the digital educational tools to be developed to mathematics education.
- Seminars and workshops can be held for PMT to increase their subject knowledge on how different methods, techniques and strategies can be used in teaching mathematical concepts as part of the teaching principles and methods course. Seminars and workshops can be organized on teaching methods, techniques and strategies based on topics, learning outcomes and learning objectives.
- PMT should be given experience in digital learning platforms. In this context, PMT can be provided with experience in designing and managing activities such as interactive simulations, virtual laboratories and collaborative project work that can be done through digital learning platforms.
- PMT should be provided with training to help them recognize the features of digital learning platforms, such as tracking student progress, providing feedback and assessment.
- Practical seminars can be organized for PMT on integrating digital learning platforms into their lessons. Within the scope of these seminars, PMT can be provided with information on how to develop lesson materials and activities using different platforms.
- Training programs can be organized for PMT who do not integrate digital learning platforms into their lessons or who integrate them only partially. These programs can cover topics such as the instructional design of platforms, content development, creating interactive learning activities and their use in assessment processes.
- Special training can be offered to PMT to eliminate the perception that the use of digital platforms complicates classroom management. It is recommended that these trainings focus on strategies for increasing student

engagement in lessons where digital tools are used, reducing distraction, and managing potential disciplinary issues.

- PMT can be equipped with the skills to design learning environments suitable for students with different learning styles and needs by taking advantage of the personalized and flexible learning features offered by digital learning platforms.
- In order to integrate digital learning platforms into lessons, the internet infrastructure in educational institutions should be strengthened and technological equipment (smart boards, tablets, etc.) should be provided to ensure equal access to digital platforms for students.
- Projects should be implemented to support students' access to digital learning platforms outside of school (e.g., digital library access, public internet access points).
- Training programs can be organized for PMT to increase their mastery of digital learning platforms and improve their technological tool usage skills.

Limitations of the Study

This study is limited to fourth-year students in the elementary mathematics teaching department at state universities in the provinces of Aydın, Denizli and Kars. This study is limited to the views of PMT regarding digital learning platforms, the usability of digital learning platforms in teaching and assessment processes and their contributions to mathematics education.

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