Pedagogical Perspective

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In-service mathematics teachers' considerations of technological developments and the use of artificial intelligence in mathematics teaching[1]

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Abstract

This study aims to examine mathematics teachers' views on technological developments in their fields and their thoughts on using artificial intelligence in mathematics learning and teaching. In recent times, when technological developments have accelerated, studies have been carried out on integrating these developments in education. In terms of mathematics education, there is a need for studies on the use of technology in the classroom environment. Twenty mathematics teachers working at different levels in different regions of Turkey participated in the study. A case study, one of the qualitative research methods, was preferred. Among the findings of the study, it was seen that almost all of the mathematics teachers who participated in the research had positive views on using technological tools in education and training. In addition, it was determined that mathematics teachers put forward different opinions regarding the advantages and disadvantages of artificial intelligence in education in general and in mathematics education in particular. Among the benefits, saving time was mentioned the most, while getting students used to laziness and reducing their thinking processes were cited as the most striking disadvantages. As a result, it is important to take advantage of the fact that mathematics teachers have positive thoughts about integrating technological tools into education and training and conduct more research in this direction.

Keywords: Mathematics teachers, Artificial intelligence, Mathematics teaching.

Introduction

With the rapid technological developments in recent years, it is seen that the number of studies (e.g., Blackwell et al., 2013; Ng, 2015; Tondeur et al., 2017) on the use of technology in education, as in almost every field, is increasing daily. It is seen that technological opportunities are to be utilized in every field of education and that these studies are gradually evolving to different dimensions. One of the recent technological developments is that artificial intelligence has been put into practice in many other fields, and education has also been included in this process. Although the idea of using artificial intelligence in education is not recent (Balacheff, 1993;

Schofield et al., 1994), it is seen that studies on its use in education have increased recently with the widespread use of artificial intelligence applications (Chen et al., 2020, 2022; Crompton et al., 2022; Hwang et al., 2020; Roll & Wylie, 2016; Zawacki-Richter et al., 2019). When the conducted studies in related literature are examined, the role of artificial intelligence in education is questioned (Edwards & Cheok, 2018), and the advantages and disadvantages of using artificial intelligence in education are investigated (Crompton et al., 2022; Celik et al., 2022), the use of artificial intelligence in the context of measurement and evaluation in education (Owan et al, 2023) and systematic examination of studies on the use of artificial intelligence in education (bin Mohamed et al., 2022; Chen et al., 2020, 2022; Roll & Wylie, 2016; Zawacki-Richter et al., 2019). In their study, Ouyang and Jiao (2021) examined the evolution of the role of artificial intelligence (AI) in education (AIEd) over time and analyzed this evolution under three different paradigms. The first paradigm, AI-directed learner, refers to a process influenced by behaviorist schools in which students acquire knowledge in a structured way. AI only guides students, and students benefit from AI. The second paradigm adopts an AI-supported, learner-collaborative approach based on cognitive and socio-cultural constructivism. According to this paradigm, it is argued that learning occurs due to interaction with people, information, technological tools, and equipment in social settings. The third paradigm is the AI-empowered learning leader, which aims to strengthen human intelligence with artificial intelligence by placing the learner in the middle of artificial intelligence in education. This paradigm assumes that education is a complex adaptive system based on chaos theory. On the other hand, Alam (2021) states that artificial intelligence is utilized in education at two basic levels. The first one emphasizes AI's helping and improving roles in the educational process. The other is that AI's ability to develop different insights into structuring the scope and content of education can be utilized. With the introduction of artificial intelligence in education, new roles have started to be discussed. Edwards and Cheok (2018) claim that artificial intelligence-driven robot teachers will be introduced to the classroom. Still, they also predict that due to this development, some of the roles carried out by teachers in education may disappear, and new roles may emerge instead of these.

Artificial intelligence in mathematics education

It has been observed that technology is essential in doing, learning, and teaching mathematics (National Council for Teachers of Mathematics [NCTM], 2000), and there have been questions about whether research on technology-supported mathematics learning and teaching should develop under the responsibility of mathematics educators and researchers (Kaput & Thompson, 1994). From the past to the present, many studies on the use of technology in mathematics education have been conducted and continue to be undertaken. As one of the latest technological developments, the idea of using artificial intelligence in education, such as the idea of using artificial intelligence in learning and teaching mathematics, has been put on the agenda by mathematics educators and researchers, and research has begun to be conducted in this sense (e.g., Forsström & Afdal, 2020; Gadanidis, 2017; Lee & Yeo, 2022; Song, 2017). It has been observed that there is a minimal number of studies on the use of artificial intelligence in mathematics education (e.g., bin Mohamed et al., 2022).

Kaput and Thompson (1994) analyzed technology-supported mathematics education research in their study on technology in mathematics education research in the first 25 years of a notable journal in mathematics education. In this study, they mentioned applying artificial intelligence to skill-based learning and teaching in education and underlined the insufficiency of technology-

related research in mathematics education. Song (2017) proposes a virtual learning-by-teaching environment by adopting a learning-by-teaching approach for the act of learning and designing a computer-mediated teachable agent system for mathematics learning. This study is seen as an effort to utilize artificial intelligence in mathematics teaching. Forsström and Afdal (2020) investigated the effectiveness of robot-based mathematical tools in problem-solving activities in designing, constructing, and using robots for mathematics teaching. As a result of the research, it was stated that students deepened their formal mathematical knowledge through robot-based activities. In another study on using artificial intelligence in mathematics education, Lee and Yeo (2022) conducted design research to develop pre-service teachers' interactive teaching skills by designing an artificial intelligence-based chatbot to experience interactive teaching in mathematics education. The study showed that the chatbot provided comprehensive and realistic answers to the preservice teachers' questions. It is revealed that the developed chatbot can improve pre-service teachers' ability to respond to students' questions.

Although many studies have been conducted on the use of technology in education, teachers have a vital role in implementing the results of these studies or using technology in the classroom environment (Bauer & Kenton, 2005; Ertmer, 2005). Studies reveal different barriers to technology use in the classroom (Chen, 2008; Ertmer, 2005; Keengwe et al., 2008). While external factors such as limited access, lack of time, support, resources, and training are cited as barriers to adequate technology integration into the classroom environment, negative attitudes, beliefs, practices, and resistance are cited as internal factors (Ertmer, 1999). On the other hand, in another study, it is seen that the reasons for the deficiencies in the use of technology in the classroom environment are classified as teacher-related and school-related reasons (British Educational Communications and Technology Agency [Becta], 2004). It is seen that teacher-related reasons are defined as a lack of confidence in teachers, resistance to change, negative attitudes, and inadequacy of teachers. In addition, it is argued that teachers' pedagogical beliefs are also effective in using technology in the classroom (Ertmer, 2005). In the study conducted by Celik et al. (2022), research on teachers' use of artificial intelligence applications was examined. The research results showed that artificial intelligence provides essential opportunities for advanced planning, such as determining student needs and taking these needs into account, implementing situations such as teachers' instant feedback and interventions, and evaluating teaching processes.

Various theoretical foundations have been developed and offered by several researchers to explain the reasons why individuals need to accept and use technology and technological tools in their works (e.g., Ajzen, 1991; Davis, 1989; Davis et al., 1989; Jackson et al., 1997; Venkatesh & Davis, 2000; Thompson et al., 1991; Venkatesh et al., 2003; Venkatesh & Bala, 2008; Venkatesh et al., 2012). One of the most well-accepted theoretical models is the Technology Acceptance Model (TAM) proposed by Davis (1989) based on social psychology theory and the Theory of Reasoned Action (TRA) asserted by Fischbein and Azjen (1975). According to the model, people accept or reject technologies in their work and lives due to some factors. One of the important factors is perceived usefulness, which is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance." (Davis, 1989, p. 320). Another factor influencing people's preferences regarding whether to use technology is perceived ease of use. This factor is "the degree to which a person believes that using a particular system would be free of effort." (p. 320). These factors were considered significant determinants of

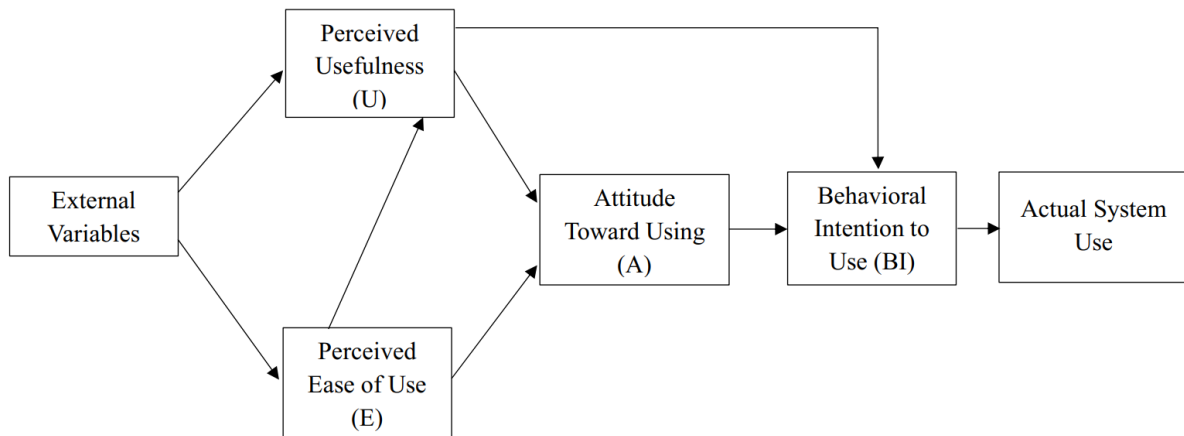human behavior toward technological tools in adopting and using them.

Figure 1 Technology Acceptance Model, TAM (Davis et al., 1989)

TAM has been applied to various disciplines and areas to reveal the degree of technology acceptance and usage. In this regard, teachers are in a pivotal position in the education system to adopt innovative developments in teaching. Therefore, for teachers to integrate technological developments into the classroom environment (Straub, 2009), it is significant that they first develop perceptions and thoughts about these technologies in terms of their usefulness and ease of use. The TAM provides a strong basis for representing teachers' technology acceptance and usage (Scherer et al., 2019).

In an educational context, the significance of the integration of emerging technologies into teaching and learning tasks appeared to be emphasized in various research (Bishop & Spector, 2014; Davies & West, 2013; Jhurre, 2005; Tondeur et al., 2012), several studies reported that there were a broad range of obstacles to technology integration in education (Francom, 2020: Schoepp, 2005; Tosuntaş et al., 2019). Hew and Brush (2007) identified six types of barriers because of an intense review of literature, namely "... (a) resources, (b) institution, (c) subject culture, (d) attitudes and beliefs, (e) knowledge and skills, and (f) assessment." (p. 226). The researchers proposed distinct strategies categorized into five main sections to remove the obstacles.

Teachers' awareness about the recent developments of technologies in their disciplines or education in general becomes important in the professional development of teachers (Elm & Liljestrand, 2024; Thappa & Baliva, 2021). However, when the related literature is examined, there are very few studies on how much teachers are aware of technological developments and what they think about the latest technological developments in education and their fields. Nazaretsky et al. (2022) investigated teachers' confidence in and attitudes towards AI-based educational tools. They suggested effective professional development strategies to increase teachers' confidence and willingness to use these tools in the classroom. The study concluded that increasing teachers' theoretical and practical knowledge about AI technologies is essential to boost their confidence. In this context, it becomes necessary for teachers to follow technological developments and professional development. This study aims to determine the extent to which mathematics teachers are aware of technological developments in their field and their views and opinions on using artificial intelligence in mathematics teaching and learning. The results of this

study are intended to make a meaningful contribution to the related literature.

Method

In this part of the study, the research design, sample selection, data collection, validity and reliability of the data collection tools, and data analysis were presented.

Research design and sampling

The case study method was used, one of the qualitative research methods considered appropriate for the research. Qualitative research investigates a phenomenon or situation in its natural environment and tries to make sense of and interpret these phenomena or situations by the researcher (Creswell, 2013). The case study technique is used to deeply understand and analyze a complex social phenomenon in its natural environment (Yin, 2014). The participants of the study were 20 mathematics teachers (twelve men and eight women) working in different provinces and levels in schools affiliated with the Ministry of National Education in various regions of Turkey, selected by purposive sampling. In the purposive sampling method, it is essential to select participants who have experience with the research phenomenon and obtain rich data from them (Patton, 2015).

Data collection

The researchers developed a questionnaire containing open-ended questions to collect the data for the study. These open-ended questions were created as a result of an intensive review of the relevant literature and the knowledge and experience of the researchers. This data collection tool consists of demographic data of teachers and seven open-ended questions related to the research subject. This questionnaire, which includes open-ended questions designed by the researchers, was sent to an expert in the field, and expert opinion was obtained. In line with the experts' suggestions, the final version of the questionnaire was formed. The open-ended questionnaire was sent to the participants using social communication tools, and they were asked to fill it out in writing. Then, the answers the participants gave to this questionnaire were analyzed, and semi-structured interviews were conducted with five of the 20 participants. These interviews were audio and video recorded with the permission of the participants.

Data analysis

After the data were collected, the researchers analyzed the participants' written answers to the questionnaire and the audio recordings of the semi-structured interview after they were transcribed. Some of the data were analyzed using a descriptive analysis method. Content analysis was started with the codes obtained as a result of an intensive review of the relevant literature. Open coding was performed with the new codes that emerged during the data coding process. Categories were formed from the codes that were obtained by previous literature and the ongoing raw data reviewing process. Both researchers first coded approximately 20% of the data separately and then came together and tried to reach a common understanding by determining the agreed codes and codes that were coded differently. Due to privacy principles, the actual names of the participants were not used. Instead, participants were coded as MT1, MT2, MT3, etc. After reaching the appropriate value in inter-coder consensus (Miles & Huberman, 1994), one of the researchers coded the remaining data. Then, themes were obtained from the categories by the researchers from the aim of the research and, and the data were analyzed using

the content analysis method.

Validity, reliability, and ethical considerations

Although the concepts of validity and reliability are used differently in qualitative research than in quantitative research, it is seen that many approaches have been put forward to meet these concepts. Lincoln and Guba (1985) stated that several conditions must be met to discuss the reliability of research. These are credibility, authenticity, transferability, dependability, and confirmability. Creswell and Miler (2000) mentioned the strategies used by researchers to ensure the validity of their studies. The main ones are long-term participation and continuous observation, triangulation, peer review and questioning, negative case analysis, rich and intensive description, and external controls. From this point of view, the strategies stated by Lincoln and Guba (1985) and the strategies emphasized by Creswell and Miller (2000) were considered and applied in this study. Regarding reliability, it is crucial that the data are obtained and recorded securely and that the coders have a high consensus when coding the data. Miles and Huberman (1994) stated that the consensus between coders should be 80%. In this study, voice recorders were used to collect the data, and they were transcribed with little time. The voice recordings were kept on a secure recording device, and the data was ensured to be safe. In addition, in the data analysis, the researchers first coded the data separately and then came together and tried to reach a common consensus for the differently coded cases. The percentage of inter-coder consensus was calculated as 85%.

Findings

This section presents the research findings, which the researchers demonstrated in a general to specific order after the data analysis. Table 1 gives teachers' opinions about using technology in mathematics teaching.

Table 1 Thoughts on the use of technology in mathematics teaching

Codes	Frequency
Fatih project and smart boards provide a significant advantage and convenience.	10
It supports the move from concrete to abstract.	6
It adds visuality.	6
It attracts the students' attention.	3
It saves time.	4
It allows plenty of question solutions.	3
Provides distance education opportunities.	2
Develops three-dimensional thinking skills.	2

As a result of the analysis, half of the teachers stated that the Fatih project and smart boards are of great advantage and provide convenience in mathematics teaching. When ranked according to the frequency of mention, it was noted that technology provides the principle from concrete to abstract in mathematics teaching and that students can visualize the subjects and figures explained thanks to technology. As with other ideas, it was stated that it attracts students' attention, saves time, solves more questions in mathematics teaching thanks to technology, enables students to participate in distance education, and supports 3D thinking. MT8 expressed his thoughts on this subject as follows:

> "The use of technology in mathematics teaching is endless, but training on these issues should be done actively rather than forced seminars."

Table 2 Programs and tools used in lessons

Codes	Frequency
GeoGebra	6
Z-book	11
Graphical tablet	3
Other applications (Canvas, Kahoot, Centimeter, Quiz, Word wall, Desmos, Tinkerplots, Phet)	3
There is no smartboard.	3

In the study, the participant teachers were asked whether they used any programs in their classes or not. The analysis revealed that more than half of the teachers stated that they used Z-book. Six teachers stated that they actively used GeoGebra in their lessons. They also used applications such as graphics tablets, canvas, Kahoot, centimeter, quiz, word wall, Desmos, and Tinkerplots. Very few teachers stated that there is no intelligent board in their schools. MT6 expressed his thoughts on this issue as follows:

> "I received training on using such programs during my university education. Although the school I was assigned to is in the city center, I cannot do anything because there is no smart board."

When teachers were asked whether they follow technological developments related to their fields, four teachers stated that they do, while 16 teachers said they do not. Five teachers said they generally follow the innovations in question solutions, lectures, and the methods of phenomenal teachers on social media. In comparison, three teachers stated that they mostly follow the changes in the curriculum. Regarding this issue, MT10 said the following:

> "When you asked these questions, I realized I usually study focused on the exam. I do notdo not follow technological developments in my field. If you asked me about the subjects with the most questions last year, I would tell you all of them immediately. The system, oriented towards solving questions and exams, pushes me towards this. I could follow these technological programs if a more comfortable curriculum and education system existed."

While MT3 stated that he participated in online code-writing activities for mathematics teachers, MT14 stated that he closely followed technological developments and that different materials emerged in the latest STEM applications.

Participants were asked whether they followed technological developments related to their fields. While most of the teachers (n=16) stated that they did not, very few said they did.

In the study, teachers were asked whether they had heard of artificial intelligence and whether they had knowledge about it. While all teachers stated that they had heard of it, eight teachers stated that they did not have any knowledge, and 11 teachers could exemplify by stating that they knew. While chatbot applications, face recognition systems, Siri applications, and robot vacuum cleaner examples stand out in the examples given by the teachers who stated that they are knowledgeable about AI, MT19 gave an example of a metaverse application. MT2, MT16, and MT17, who indicated that they did not know, said that they had heard about artificial intelligence from TV series and that it seemed dangerous.

Table 3 Thoughts on the use of artificial intelligence in education

Categories	Codes	Frequency
Positive	It can facilitate learning.	5
	It can provide data diversity	3

	Engage students' interest	2
	Identify students' learning.	1
	Provide information quickly and accurately.	5
Negative	Lack of audibility, limitation effect	2
	Technology might yield addiction	3
	It can make the student lazy.	8
	Lack of emotionality	2
	It could put teachers out of work.	4
	The focus may shift.	1
	Questionable accuracy	1
Neutral	A balanced path must be followed	2
	No idea	4

Teachers were asked their opinions on using artificial intelligence in education. Teachers' responses were analyzed under three headings: positive, negative, and neutral thoughts, and are given in Table 3. When the positive thoughts are examined, it is mainly stated that it will facilitate learning and provide easy and accurate access to information, while three teachers' statements that it will provide data diversity, two teachers' statements that it will attract students' interest, and one teacher's statements that it can detect students' learning come to the fore. When the negative opinions were examined, it was seen that it was mostly stated that it would make students lazy (n=8). Some teachers noted that the use of artificial intelligence in education would have negative consequences for teachers, that it would increase technology addiction, that it would be difficult to control and limit, that it would be devoid of emotionality, and that it would have negative consequences for teachers. When neutral opinions were analyzed, few teachers stated that a balanced path should be followed. Four teachers indicated that they did not have any information on this issue.

Table 4 Opinions on the purposes of using artificial ıntelligence in mathematics teaching

Codes	Frequency
Teaching of topics	5
Gaining simulation-supported experience	2
Solution of questions	6
Individual teaching	5
Student Coaching	1
Use in the measurement and evaluation process	3
Fast question screening	1
Smart absence detection	1
I have no idea.	6

Teachers were asked whether artificial intelligence could be used in mathematics teaching and, if so, in which areas, and all teachers answered yes. According to Table 4 above, the main issues frequently mentioned by the teachers in the use of artificial intelligence in mathematics teaching were the teaching of subjects, individual education, and question-solving. On the other hand, three teachers stated that it could be utilized in the assessment and evaluation process, two teachers indicated that it could be used in simulation-supported experience gaining, one teacher said that it could be used in student coaching, one teacher stated that it could be used for quick question scanning thanks to artificial intelligence. One teacher stated that it could be used for absenteeism scanning. Six teachers indicated that they had no information on this subject and could not comment. On this subject, MT10 stated the following:

> "If we think of mathematics teaching in three stages, we can think of the sequence as belief,

continuity, and question solution. To increase success, learned helplessness must first be broken; there is no need for artificial intelligence here. This process is emotional, and the teacher should do it. As for persistence, math is a course where the results can sometimes be obtained months later. Here, artificial intelligence can be a tracking mechanism that can force students to study without giving up. It can fulfill the task of student coaching by sending warnings and feedback at certain periods. The last stage is to solve plenty of questions after studying the subject. Mathematics is a subject with multiple methods. Thanks to artificial intelligence, a notebook with all formulas and solutions can be created, and students can determine their path."

Teachers were asked about the advantages and disadvantages of using artificial intelligence in mathematics teaching. The findings related to this situation are presented in Table 5.

Table 5 Mathematics teachers' views on the advantages and disadvantages of using artificial intelligence in mathematics teaching

Categories	Codes	Frequency
Advantages	Giving an unlimited number of examples	3
	Involving different teaching styles	1
	Facilitating understanding	2
	Saving time	8
	Increasing student interest	3
	Adding visualization	3
	Facilitating assessment and evaluation processes	3
	Providing accurate information	2
	Providing permanence	2
Disadvantages	Questioning compliance with ethical rules and moral values	1
	Causes health problems	2
	Excessive time expenditure	2
	Accustomed to laziness and reduced thinking processes	10
	It causes physical problems (such as electricity, internet, etc.).	2
	Individualization of education	1
	Decrease in permanence due to the elimination of trial and error	1
Neutral	No idea	2

According to Table 5, one of the advantages of using artificial intelligence in mathematics teaching was that it would save time. As other advantages, it was stated that it would provide unlimited examples, enable different teaching styles, facilitate comprehension, attract student interest, provide visualization, facilitate the measurement and evaluation processes, allow access to accurate information, and provide retention. Among the disadvantages, the most frequently mentioned ones were that students would get used to laziness, and their thinking processes would decrease. As other disadvantages, it was stated that it would be difficult to question compliance with ethical rules and moral values, students would spend excessive time, and physical problems; since the education would be individualized, it would appeal to a single type of student, trial, and error would be eliminated, and therefore permanence would decrease. Six teachers stated that they had no opinion. MT11 expressed his thoughts on this subject as follows:

"It enables the teacher to use their time efficiently and to progress quickly in the lesson. Artificial intelligence can have a significant place not only in the introduction phase but also in the evaluation phase. In the mock exam results, it can be quickly determined which subject the students are deficient in. Therefore, it is a great advantage in the measurement and evaluation phase. The disadvantage of artificial intelligence may be that education is

individual and learning capacity is different. I think reaching every student is not enough in its current form."

While MT1 stated that "it is difficult to investigate its compliance with ethical rules and moral values" among the disadvantages of artificial intelligence, MT2 stated that "artificial intelligence will make students more connected to the screens, so it may cause students' eyes to deteriorate and cause back discomfort from sitting constantly."

Teachers were asked whether artificial intelligence could replace mathematics teachers; 7 teachers stated it could, and 13 teachers stated it could not. Some teachers noted that it cannot be replaced because robots lack emotions and feelings, so it is impossible for them to understand students fully. MT15, MT17, and MT18 stated that it would not be possible for artificial intelligence to know every possibility about feedback to students and that it would need more than just instant feedback. MT10 summarized his thoughts on this issue as follows:

> "Yes, the need for teachers has decreased; now there are question solution QR codes, and students solve questions by following them. However, this does not mean that there is no need for a teacher. If a robot comes, it is tempted by all combinations but cannot make jokes; it can hurt the student. One of our friends who sent a question to the Ministry of National Education made a definition such as we can express the angle with the distance between the fingers, and it was rejected because if there are students without fingers, they may get hurt, robots cannot do these things, they cannot be aware. We think they cannot think. A better education is possible with robots and teachers who know technology, not teachers who use old traditional methods."

MT19 stated that "artificial intelligence can replace the teacher, but it will be insufficient in giving feedback to the questions posed by children in some situations." In contrast, MT20 stated, "A man-made thing cannot be more valuable than a human being and cannot replace him/her."

In summary, mathematics teachers expressed their ideas about the purpose of using AI in mathematics teaching and mentioned the possible advantages and disadvantages of using AI in mathematics education.

Discussion and conclusion

This study aims to reveal the views and opinions of mathematics teachers on using artificial intelligence in education and training. In recent years, technological developments have seriously affected almost every field, including the field of education. The emergence of artificial intelligence and the significant progress made in this field have brought to mind the idea that this technology can also be used in education and training. In this sense, it is essential to investigate teachers' readiness for this technology as the implementers of education and training programs. For this reason, this study is necessary to reveal whether teachers are aware of technological developments and their opinions and thoughts about using artificial intelligence, which emerged as an innovative technology, in teaching.

The findings of this study show that mathematics teachers have positive opinions about the use of technology in mathematics teaching. Teachers emphasized that technological tools would provide a significant advantage and convenience, attract students' attention, add visuality to the lessons, support progress from concrete to abstract, save time, and provide plenty of question solutions. Teachers' views on using technological tools in the classroom environment support the results of the study conducted by Lee and Yeo (2022). In addition, Ertmer (2005) stated that

teachers' thoughts and beliefs are practical in using technology in the classroom environment, which is in line with the findings of this study. Mathematics teachers' positive opinions and thoughts about using technological tools such as artificial intelligence in the classroom environment can be supported to increase their self-confidence. Teachers reach these thoughts using their previous education, knowledge, and experience.

The results of the current study revealed that teachers have different opinions about the use of artificial intelligence in education and training. Unlike the results of Celik et al. (2022), while some teachers stated that it can facilitate learning and provide information quickly and accurately as positive aspects, on the other hand, some teachers expressed negative reservations that it can make students lazy and cause teachers to be unemployed. These results support the results of the study conducted by Edwards and Cheok (2018). The participants were observed to mainly mention problem-solving, subject teaching, and providing individualized instruction for using artificial intelligence in mathematics teaching. Teachers stated some advantages and disadvantages of using AI in mathematics teaching. Among the benefits, saving time was mainly mentioned, while disadvantages, such as making students lazy and reducing their thinking processes, were noted. Teachers may have said these based on their knowledge and experience. The study of Nazaretsky et al. (2022) reveals that teachers can develop essential ideas about using artificial intelligence in mathematics teaching with the training they will receive in this field. It may be vital for them to hear them in practice. Therefore, in-service training can be provided to teachers to develop their knowledge and skills in using technological tools, especially for the sake of utilizing AI in their classrooms.

As the limitations of this study, these results do not reflect the opinions of mathematics teachers in general and only show the opinions and thoughts of twenty mathematics teachers who participated in the study. In addition, the views and opinions of the teachers may only partially represent the situation in their classrooms because they were not observed unbiasedly.

Kaput and Thompson (1994) have argued that research on technology in mathematics education still needs improvement. Still, more practical research is needed on integrating technology into the classroom environment. Based on the results of this study, studies can be conducted on the effective use of technology and artificial intelligence in mathematics teaching in the classroom. It can be ensured that mathematics teachers are aware of the mathematics teaching software used worldwide and that they learn, internalize, and use such programs in their lessons in the classroom environment so that students can be taught more effectively.

Statement of researchers

Researchers' contribution rate statement:

The authorship contribution for this paper is as follows: the first author contributed 50%, the second author contributed 30%, and the third author contributed 20%.

Conflict statement

There is no conflict of interest with any institution or person within the scope of the study.

Support and thanks

No support.

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