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INVESTIGATION OF SCIENCE TEACHERS' ANXIETY ABOUT ARTIFICIAL INTELLIGENCE: A PHENOMENOLOGICAL STUDY

Abstract: This study aims to examine science teachers' views and concerns about artificial intelligence (AI). Phenomenology design, one of the qualitative research method designs, was used in the study. The study group consisted of five science teachers, one doctoral and four master's degree graduates. Semi-structured interview was preferred as a data collection tool. Inductive content analysis was used to analyze the data. Participants defined AI as robots with humanoid behavior and alternative learning tools. Teachers stated that AI increased academic achievement, motivation and class participation rate. It was found that the participants' concerns about AI stemmed from lack of experience and knowledge, security issues and reliability of information. It was also concluded that the participants were concerned about workload, asocialization, decrease in skills, and privacy of personal data. The participants stated that they had problems in terms of being technologically inadequate, not being able to adapt to AI and lack of knowledge, inadequate AI outputs, and difficulties in applied trainings. It is recommended that science teachers should be given practical trainings to reduce their concerns about AI.

Keywords: Anxiety, artificial intelligence, science teachers, fenomenology

Introduction

The methodological foundations for the concept of artificial intelligence (AI) date back to ancient times (Flasinski, 2016). On the other hand, the construction of AI systems was only possible after the discovery of computers in the twentieth century (Buchanan, Feigenbaum, & Lederberg, 1971). Alan Turing developed the "Turing Test" in 1950 to determine whether a computer could imitate human intelligence. In 1956, a group of researchers at Dartmouth College, including Marvin Minsky, designed a project on the feasibility of creating machines that could simulate human-like intelligence (McCarthy, Minsky, Rochester, & Shannon, 2006). This development process has led to different definitions of AI (Chassignol, Khoroshavin, Klimova, & Bilyatdinova, 2018). Marvin Minsky defines AI as machines that can perform tasks that require human intelligence (McCarthy et al., 2006). In this context, AI is seen as a field that includes theories, methods, technologies and their applications to mimic, extend and improve human intelligence (Jiang, Li, Luo, Yin, & Kaynak, 2022). Today, AI has a great importance in many sectors such as health (Oh, Lee, Eun, & Park, 2022), tourism (Kilichan & Yilmaz, 2020), transportation and logistics (Zhu, Shi, & Liu, 2022), education (Huang, 2022). In particular, AI is used in education with applications such as intelligent tutoring systems and teaching

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robots (Ouyang & Jiao, 2021). In today's world where technological advances are gaining momentum, it is inevitable that the education sector will be at the forefront of this transformation.

AI technology tools (e.g. smart robots and adaptive learning systems) are increasingly being used at various levels of education (Chen, Chen, & Lin, 2020). AI in education is a field related to the development of computers that perform cognitive tasks similar to human intelligence (Baker, Smith, & Anissa, 2019) and has been in existence for over 30 years. The main purpose of using AI in education is to enhance students' learning experiences effectively and efficiently (Chen et al., 2020). The use of AI technology in education offers students personalized and autonomous learning modes, in addition to balancing the processing of educational resources (Wang, Sun, & Zhou, 2023). The use of AI is not limited to the presentation of a lecture or the evaluation of an exam, but aims to maximize the potential of each student by transforming the educational process from start to finish. In this context, AI is used in monitoring and evaluating students' performance (Lau, Sun, & Yang, 2019), providing personalized learning experiences to students (Mendoza, Hutajulu, & Lubis, 2022), classroom management (Mu & Shi, 2022), and facilitating learning and decision-making processes (Hwang, Xie, Wah, & Gasevic, 2020). On the other hand, it is thought that individuals may face many difficulties with AI technologies that are developing rapidly (Filiz, Guzel, & Sengul, 2022). Emerging and potential challenges can trigger individuals' AI anxiety. Bulut, Kinoglu, & Karaduman (2024) stated that AI brings many facilitating effects as well as anxiety-inducing situations in learning environments. The reasons for these concerns include the idea of AI getting out of control (Johnson & Verdicchio, 2017), the idea of AI being unreliable (Bochniarz, Czerwinski, Sawicki, & Atroszko, 2022), and the concern of not being able to learn new things about AI (Nasreldin Othman, Mohamed Zanaty, & Mohamed Elghareeb, 2021). Although it is inevitable that computerization and automation will take over human work, the essential role of teachers in education remains (Frey & Osborne, 2017). In addition, in an environment where digitalization and AI use have become widespread, it is important to determine teachers' concerns about AI (Ulukapi Yilmaz & Yilmaz, 2024).

Present Study

When the literature is reviewed many studies have been conducted on AI anxiety. Li and Huang (2020) created an eight-factor model by investigating the dimensions and acquisition of AI anxiety. Fortuna, Lysiak, Chumak, & McNeill (2022) examined human interactions with humanoid robots and concluded that these interactions form positive hybrid systems and that human perceptions and concerns play an important role in the design of these systems. Banerjee and Banerjee (2023) examined the AI-induced anxiety levels of college teachers according to their gender and teaching experience and found no significant difference between these variables. Hopcan, Turkmen, & Polat (2024) concluded that pre-service teachers do not have learning concerns about AI, but they are concerned about its effects on workforce and social life. Given that teachers have a fundamental role in the education system, technological acceptance and adaptation in education is important to adapt to the AI-driven world. Therefore, teachers' concerns play a decisive role for the proper use of AI in the field of education. The general purpose of the study is to determine the views and concerns of science teachers regarding AI. As a matter of fact, the use of AI in science education is becoming increasingly widespread (e.g. Cooper, 2023; Shin & Shin, 2020). Akhmadieva et al. (2023) stated that science education will undergo significant changes with AI. Cooper (2023) stated that despite being in the early stages of change, AI is beginning to have far-reaching effects on science education. In this context, teachers' knowledge, skills and perspectives regarding AI become important (Antonenko & Abramowitz, 2023). As a matter of fact, Huang, Saleh, & Liu (2021) stated that AI is changing the way teachers teach. However, the perspective on AI, especially in K-12 education, effects the future of societies (Frank et al., 2019). In order for K-12 students to acquire AI skills that effect their future career choices (Antonenko & Abramowitz, 2023), it is important to identify teachers' perspectives and concerns towards AI (Hopcan et al., 2024). As a result of these evaluations, in the current study, an answer to the question of how science teachers' views and concerns about AI are sought.

Method

Research Model

This study was conducted in the phenomenology design, which is one of the qualitative research designs. The main purpose of this design is to understand the essence of the experiences of individuals who live a certain phenomenon in depth (Webb & Welsh, 2019). In this study, which aims to determine science teachers' views and concerns about the use of AI, phenomenology design was preferred.

Study Group

In studies based on phenomenology design, it is necessary to work with individuals who have experiences related to the phenomenon in order to understand the phenomenon accurately and clearly (Patton, 2005). In this context, criterion sampling, one of the purposeful sampling types, was used to determine the study group. The study group of this study consists of five science teachers working in various schools in Central Anatolia Region. The criterion for determining the study group is the use of AI by science teachers in their educational and instructional activities. Participants have at least a master's degree.

Data Collection Tool and Process

In this study, data were collected using semi-structured interviews. The semi-structured interview allows participants to convey their perceptions and thoughts in their own words. In this context, the "Artificial Intelligence Anxiety Interview Form" prepared by the researcher was used. While preparing the form, studies on artificial intelligence and anxiety both in Turkiye (e.g. Filiz et al., 2022) and abroad (e.g. Banerjee & Banerjee, 2023; Wang & Wang, 2022) were reviewed. The form was created as a result of the examination of these studies. For the content validity of the data collection tool, the "Artificial Intelligence Anxiety Interview Form" was examined by two experts in the field of science education and AI. Before starting the interview, the participant was informed that a voice recording would be made and the interviews were started after obtaining the necessary permission. During the interview, important points were noted down by the researcher and the accuracy of the teachers' statements was immediately confirmed. During the interview process, conversations or statements that would direct the teachers were avoided.

Data Analysis

In this study inductive content analysis was used. Considering that the study was conducted with a phenomenological design, the data were analyzed using Colaizzi's (1978) seven-step method. The first step in this method is the creation of formulated meanings. In this context, the meaning units were determined by analyzing the participants' answers to each question. In the second step, the formulated meanings are collected into category clusters. At this stage, the meaning units obtained in line with the participants' answers were grouped under appropriate categories. For example, the effects of AI-supported learning tools on students were grouped under the categories of cognitive, affective and negative effects. In the third step, a comprehensive description of the participants' experiences is written by integrating the results of the phenomenon. In the fourth step, the basic structure of the phenomenon is determined. In the fifth step these constructs are sent back to the participants for validation. In the sixth step, participants' feedback is reviewed and the analysis is revised if necessary. Finally, in the seventh step, the process of analyzing the data is completed. In this framework, all the explanations of the participants were transcribed into written text, codes, categories and themes were created from the answers given by the participants, and data analysis was completed by following the steps above.

Validity and Reliability

In order to ensure the validity and reliability of the study, the views of the participants were transcribed, confirmed by the participants themselves and included in the study with direct quotations without any changes (Creswell, 2007). In order to ensure the face and content validity of the interview form, expert opinions were taken while creating the form and pilot applications were carried out before the research. In the presentation of the findings, the participants' own statements were used and supported with direct quotations. Participant approval and expert opinions were taken to increase internal validity (Patton, 2005). Two experts in the field of science education were interviewed and two science teachers were pre-interviewed. In addition, direct quotations related to the codes were added to the findings section. Purposive sampling method was adopted to ensure external validity, rich descriptions were made during the literature review and coding was carried out by more than one researcher. (Lincoln & Guba, 1985).

Results

In this section, the findings obtained as a result of the analysis are presented respectively. Participant opinions regarding the codes are directly quoted.

Table 1. Definition of AI

Category	Code
General definition	Robot exhibiting humanoid behavior (P2, P3, P5)
	Facilitating tool (P1)
	Alternative learning tool (P4)

When Table 1 is examined, it is seen that the participants made three different definitions of AI. P2, P3 and P5 defined AI as robots that exhibit humanoid behavior. P3 expressed her opinion regarding this definition as *"I can broadly define AI as a computer or a robot with the help of a computer responding to us like a human, answering our questions or behaving like us."* While P1 defined AI as a facilitating tool, P4 defined AI as an alternative learning tool. P4 expressed her opinion regarding this definition as *"I consider the AI we currently use in education as an alternative learning tool."*.

Table 2. The use of AI in education

Category	Code
	Assessment and evaluation (P1, P2, P3, P5)
	In-class activity (P1, P2, P3, P4, P5)
Purpose of use	Classroom management (P1, P3)
	Preparing a lesson plan (P1)
	Out-of-class activity (P4, P3, P5)

All of the participants stated that they used AI to prepare in-class activities. P2 expressed her opinion in this context as *"...I explain the concepts we have just learned by asking Chatgpt and by making additions myself. In this way, students participate more in the lesson."*. P1, P2, P3 and P5 stated that they used AI in students' assessment and evaluation processes. P5 expressed her opinion as *"In assessment and evaluation, I usually use it to create questions appropriate to the level of the student."* P3, P4 and P5 stated that they also used AI in extracurricular activities. P5 expressed her opinion on this as *"I can ask students to design a visual or prepare a video on a topic using AI. When they come to class, I review their work and give feedback."* P3, one of the two participants who stated that she used AI in classroom management, expressed his opinion as *"By utilizing various AI tools, more effective teaching and management can be achieved in the classroom. For example, video applications can be opened, interactive work can be done with visuals and questions can be asked..."* Finally, P1 stated that she used AI to prepare lesson plans.

Table 3. *The Effects of AI Supported Learning Tools on Students*

Category	Code
Cognitive Effect	Increased academic achievement (P1, P2, P3, P5)
	Problem solving skills (P1)
	Development of language skills (P4, P5)
	Critical thinking skills (P5)
Affective Effect	Motivation increase (P1, P2, P3, P4, P5)
	Increase in class attendance (P1, P2, P3, P4)
	Positive attitude (P4, P5)
Negative Impact	Deterioration of creative thinking skills (P2, P3)
	Decreased social skills (P3)

When Table 3 is examined, the effects of AI-supported learning tools on students are examined in three categories: Cognitive, affective and negative. All participants except P4 stated that AI supported learning tools increase academic achievement in students. P2 expressed this opinion as *"... in fact, students also learn how to do research and this, of course, positively affects their academic achievement."* P4 and P5 stated that AI supported learning tools contribute to students' language development. P4 expressed her opinion in this context as *"In order for AI to create the image the student wants, the student needs to express themselves in words. This actually causes students to improve their language skills and express themselves better."* P1, who stated that AI learning tools improved students' problem solving skills, expressed her opinion on this situation as *"I think that many skills are developed depending on the type of tool we use and the activity we do. For example, when we design an activity for problem solving, the student's problem solving skills are also developed."* Participants stated that AI-supported learning tools also have affective effects on students. All participants stated that AI-supported learning tools increase students' motivation. P2 expressed her opinion in this context as *"Since students are fond of technology, AI attracts more attention than a normal lecture and definitely motivates students more."* P5 expressed her opinion as *"As it is known, the use of computers and smart devices motivates students in the digital age..."*. P1, P2, P3 and P4 stated that AI supported learning tools increased students' participation in the lesson. P3 expressed her opinion in this context as *"AI tools are remarkable in terms of class participation. In order to understand the language of the students, we need to act like them. Therefore, I believe that when we use AI, we will increase students' participation in the lesson."*. P4 and P5 stated that AI supported learning tools developed positive attitudes towards the course. P2 and P3 stated that AI supported learning tools also have negative effects on students. P2 expressed her opinion in this context as *"I feel like it pushes students to be a bit ready-made in terms of homework because students have some of their homework done by AI".*

Table 4. *The Impact of AI Tools on Teaching Practices*

Category	Code
Changes in Teaching Practices	Effective use of time (P1)
	Tracking student progress (P1)
	Assessment and evaluation (P1, P3, P5)
	Adaptation to technology (P2)
	Ease of doing work (P3)

When Table 4 is analyzed, it is seen that the participants stated that AI tools would change their teaching practices. P1, P3 and P5 stated that AI would create significant changes in assessment and evaluation processes. P1 expressed her opinion in this context as *"I think AI will also affect the exam system because it can look at things from different angles and produce questions in various styles. This may change our understanding of measurement and evaluation."*. In addition P1 stated that AI tools facilitate teachers in using time effectively and tracking student progress. She explained her opinion in this context as *"... because it makes our lives much easier and allows us to do things faster. It allows teachers to save time. I think this will enable teachers to use their time more efficiently."*. Emphasizing that AI tools effect teachers' adaptation to technology, P2 explained this situation as *"When I use*

technology in my lessons, of course my lesson practice changes and this requires a different teaching approach compared to the past. I constantly update my lesson plans and avoid staying the same".

Table 5. *Teachers' concerns about AI tools*

Category	Code
Sources of concern	Lack of experience (P1, P2)
	Taking people's place (P2, P4)
	Security of personal data (P4)
	Rapid developments in technology (Lack of guidance) (P3)
	Reliability of AI outputs (P3)
	Reducing information (P3)
Not to worry	Technological aptitude (P5)

When Table 5 is examined, it is seen that P1, P2, P3 and P4 have concerns about AI tools. P1 and P2 stated that lack of experience in the use of AI tools was an important source of concern. P2 expressed her opinion in this context as "*I have knowledge and experience in technology, but when I encounter a completely new device or product, using it might make me a bit anxious. Therefore, I do not use it directly in my lesson. If I start using it immediately in the classroom environment, I would be worried because I don't know what to do.*". P1, on the other hand, stated that she does not worry when using AI tools, while someone who does not have experience may worry. She explained her opinion in this context as "*I think someone who has never used it might be worried. For example, when you take an AI program at the beginning and say "prepare a plan on this subject", the output obtained is usually not satisfactory.*". P2 and P4 expressed concern that AI could replace humans. P4 explained her opinion as "*I guess after some point, AI will do many jobs for us. The thought that it will be used in war technologies in the future scares me.*". P3 expressed concern about the lack of guidance when using AI tools, the reliability of AI outputs, and the potential for these tools to reduce people's knowledge. She expressed her opinion in this context as "*I think AI can dull people in terms of knowledge, so getting lost in such a deep pool of information can lead to a diminishing of our knowledge as individuals.*". P4 stated that she was concerned about the security of personal data when using AI tools. She expressed her opinion in this context as "*… I don't know what information she will get from me and how she will use it. This worries me a little bit*".

Table 6. *Teachers' concerns about the use of AI in education*

Category	Code
Professional concerns	Increasing workload (P1, P2, P3, P4)
	Making assessment of students difficult (P3, P5)
	Abolishing the teaching profession (P2)
	Adaptation (P1, P2)
Student-related concerns	Decreased socialization in students (P1, P2, P3, P4)
	Weakening student skills (P1, P2, P3, P4)
Ethical concerns	Confidentiality of personal data (P1, P2, P3, P4, P5)

When Table 6 is examined, it is seen that the participants' concerns about the use of AI in education are grouped under three main categories: Professional, student-related and ethical concerns. P1, P2, P3 and P4 stated that they had concerns that the use of AI in their education might increase their workload. P1 expressed her opinion in this context as "*For a person who doesn't know the technology at all, it means a workload. She has to learn and keep up with the technology. So it can be worrying.*". P1 and P2 stated that they have concerns about adapting to the rapid advances in AI. P2 expressed her opinion in this context as "*I think that teachers who do not have enough information on this subject and do not want to get information will not be able to develop their professionalism sufficiently.*". P3 and P5 stated that their students' use of AI tools created anxiety in the assessment process. P2 stated that she was concerned that the use of AI in education would eliminate the teaching profession. She expressed her opinion in this context as "*AI replacing humans may cause the need for that person to disappear with the decrease in the workload.*". P1, P2, P3 and P4 stated

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that using AI in education may weaken students' skills. P4 expressed her opinion in this context as *"I think that AI will reduce creativity because it pushes students to the easy way and causes them to think less."*. P1, P2, P3 and P4 stated that they were concerned that the use of AI in the education process might weaken the social skills of the students. P1 expressed her opinion in this context as *"Students start to talk with such programs and establish a relationship with a computer rather than among themselves. So I have some concerns about this."*. All of the participants stated that they were concerned about the privacy of their personal data when using AI during the training process.

Table 7. *Problems encountered in the integration of AI technologies into the education system*

Category	Code
Obstacles	Inability to adapt to every lesson (P2, P3, P4) Technological inadequacy (P2, P4) Failure to adapt (P1) Inadequacy of AI outputs (P2) Lack of knowledge regarding the use of AI (P2) Difficulty in applied training (P3

When Table 7 is examined, it is seen that the participants encounter various obstacles while integrating AI technologies into education and training environments. P2, P3 and P4 stated that they could not adapt AI to every lesson. P4 expressed her opinion in this context as *"… it is not possible to adapt it to every subject. Because we don't have enough AI tools for all of them."*. P2 and P4 stated that they had problems integrating AI into education due to technological inadequacies. P2 expressed her opinion in this context as *" I cannot use one hundred percent integration in class because the technology in our school is not sufficient in this regard. I see on the news that robots are taking classes abroad."*. P2 stated that the inadequacy of AI outputs and the lack of knowledge about the use of these tools can prevent the use of AI in education, and expressed her opinion in this context as *" These applications are used in a manner akin to brainstorming. However, the explanations provided by these tools are not always sufficient, so I supplement them with additional information to advance the learning process."*. P3 stated that she had difficulty in practical training while using AI. She expressed her opinion in this context as *" ..due to the lack of environmental interaction, it may be difficult to attract children's attention and enable these students, who will become professionals in the future, to acquire physical skills."*. P5 stated that she did not encounter any problems while integrating AI tools into the education process.

Within the framework of all the findings obtained, teachers' opinions and concerns regarding AI are summarized in Figure 1.
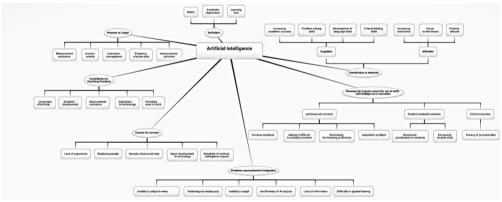

Fig 1. *Teachers' views and concerns regarding AI*

Discussion

Based on the findings, it was concluded that most of the participants defined AI as a robot exhibiting humanoid behavior. In some studies in the literature, it is seen that teachers give similar answers. McCarthy (2004) states that intelligence is found in humans, animals and some machines and defines AI as the science of making human-like intelligent computers. However, two participants defined AI as a facilitator and alternative learning tool. Based on these findings, it was concluded that teachers have knowledge about AI. Determining how teachers define AI can affect many situations from curriculum preparation to the inclusion of AI in learning processes. As a matter of fact, in this context, Yau et al. (2023) revealed that it is necessary to determine teachers' perspectives while creating AI programs. Therefore, teachers' definitions of AI are considered important. It was concluded that teachers generally use AI in assessment and evaluation, in-class activities and classroom management. Lau et al. (2019) stated that AI can be used for assessment purposes in education. Similarly, Mendoza et al. (2022) stated that AI can be used in the classroom to provide personalized learning. In this respect, the research results are similar to the literature. In addition, teachers stated that AI increased academic achievement, motivation and class participation rate. In this respect, it can be interpreted that the use of AI in education will benefit students cognitively and affective. However, some participants stated that AI may prevent students from thinking creatively and decrease their social skills. As a matter of fact, teachers may present negative opinions about the use of AI in education. For example, Haseski (2019) found that pre-service teachers stated that the use of AI in education may have negative effects. In the current study, the effects of AI on students were categorized as cognitive, affective and negative effects. Teachers state that the use of AI in education will make a difference in measurement and evaluation and will cause a change in teaching practices. In addition, the participants stated that AI tools can bring about changes in the teaching profession in terms of using time efficiently, providing ease of doing business, and facilitating student follow-up. This finding is similar to some studies in the literature (e.g. Bagir, Onal-Karakoyun, & Asilturk, 2022; Lameras & Arnab, 2021).

It has been determined that teachers have concerns about artificial intelligence tools in education. It is seen that these concerns stem from lack of experience and knowledge, security issues and reliability of information. This finding is similar to some studies in the literature (e.g. Jong, 2022; Yan, 2024). In this context, especially educators need to be equipped with basic knowledge about AI (Barbhuiya, 2023). As a matter of fact, AI anxiety, also referred to as technophobia, emphasizes a state of panic arising from the unknown aspects of the developments experienced as a result of technological developments (Johnson & Verdicchio, 2017). In order to prevent these concerns, trainings should be organized to increase teachers' knowledge and literacy about AI (Karimov, Saarela, & Karkkainen, 2024). However, it was also found that teachers have concerns about the use of AI in education. These concerns were grouped under the categories of professional concerns, student-centered concerns and ethical concerns. Teachers were found to be professionally concerned about the increase in workload, student-centered concerns about asocialization and decreased skills, and ethical concerns about the privacy of personal data. This finding is similar to some studies in the literature (e.g. Akgun & Greenhow, 2022; Hopcan et al., 2024). Although concerns about AI vary, there is a need to address these concerns reflected in education from different angles (Fernandez-Miranda et al., 2024). In this context, both teachers and other educational stakeholders are expected to take part in the development and implementation of AI use in education (Schiff, 2021). However, some teachers may resist the use of technology and have an attitude that traditional teaching is better in their classrooms. As a matter of fact, in the current study, teachers stated that there are some obstacles in the use of AI. It is seen that teachers have difficulties in terms of the fact that AI cannot be applied in every lesson, being technologically inadequate, not being able to adapt and lack of knowledge, AI outputs being insufficient, and practical trainings being difficult. In this context, regular trainings should be provided to teachers in order to prevent the concerns and obstacles that arise (Chaudhary, 2017).

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Conclusion

This study examines science teachers' views and concerns about AI. For this purpose, interviews were conducted with teachers. It was concluded that teachers generally use AI in assessment and evaluation, in-class activities and classroom management. It has been determined that teachers have concerns about artificial intelligence tools in education. It is seen that these concerns stem from lack of experience and knowledge, security issues and reliability of information. These concerns were grouped under the categories of professional concerns, student-centered concerns and ethical concerns. Teachers were found to be professionally concerned about the increase in workload, student-centered concerns about asocialization and decreased skills, and ethical concerns about the privacy of personal data.

Limitations ve Suggestions

This study has several limitations. The current study was conducted with the participation of five science teachers with at least a master's degree. In this context, comparative analyses can be carried out by including teachers from different branches in the study. As a matter of fact, AI concerns of teachers in different fields may vary (Lee, Shin, & Park, 2024). There is a research gap in the literature on AI and teacher training. In order to close this gap and reduce teachers' anxiety about AI, it is important to expand the use of AI in teacher education and to examine how these applications contribute to teachers' development. Although AI applications in education are still in their early stages, it is recommended that those who develop applications should provide training to teachers in order to prevent concerns (Chaudhary, 2017).

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