

## **An Investigation of Pre-Service Social Studies Teachers' Metaphorical Perceptions Towards the Concept of Artificial Intelligence**

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### **Abstract**

The aim of this study is to determine the perceptions of pre-service social studies teachers towards the concept of artificial intelligence through metaphors. The research was conducted with phenomenology design, one of the qualitative research methods. The participants of this study consists of first, second, third, and fourth grade pre-service social studies teachers studying at the faculty of education of a state university in Ankara. The data obtained were analyzed by content analysis method. The results showed that the most common metaphor categories produced by the participants were Help Mechanism, Serving to Purpose, Complexity, Infinity, and Damaging. On the other hand, the metaphor categories produced in common at all grade levels from the first grade to the fourth grade were Help Mechanism, Serving to Purpose and Harmful. In this study, it was found that the participants generally had positive images towards the concept of artificial intelligence. It was also determined that pre-service social studies teachers had various concerns about the concept of artificial intelligence, albeit in small numbers. According to the findings, it is recommended to conduct more extensive and comprehensive research on the concept of artificial intelligence. In addition, it was also suggested that the factors that negatively affect the perceptions of pre-service social studies teachers towards the concept of artificial intelligence should be studied through qualitative research.

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## INTRODUCTION

How the human brain works has been a subject of curiosity since the early ages. Efforts have been made to build a machine similar to the human brain (Pirim, 2006). Human beings, who met the power of steam with the Industrial Revolution, focused on “training machines” in the 1950s. Machine-centered production systems have been replaced by automation-centered production over time. With the invention of the computer, people dreamed of producing an artificial brain and advanced their work towards this goal. As a result of these studies, albeit primitive, the first examples of artificial intelligence (AI) were reached (Öztemel, 2020). It can be said that the term AI was developed based on the concept of machine learning. The AI term was first used by John McCarthy in 1956 at the “Dartmouth Conference” (Nilsson, 2019). McCarthy defined AI as “the calculable aspect of the world's capacity to achieve its goals” (as cited in Arslan, 2020, p. 76). In another definition, AI can be defined as “a set of mechanisms that reason, decide, problem solve, direct, associate, and communicate in line with the commands given by individuals” (Güzey et al., 2023, p. 70).

With the digital transformation in the world, AI has become widespread in almost every field (Adaş & Erbay, 2022). Health, agriculture, animal husbandry, data processing and education are just a few of these fields (Altun et al., 2023). Today, AI communicates with students, analyzes their needs, and meets their needs to a great extent (Chen et al., 2020). AI in education acts in line with the principle of “student relativity” and diversifies teaching by providing individualized teaching. It provides benefits for teachers as well as students, facilitates time-saving, automatic grading, and acts as a teaching assistant, making the teacher's work easier (Zhang et al., 2023, p. 3-4).

### **Social Studies Education and Artificial Intelligence**

As an important course, social studies directly related to daily life and change processes. Today, the use of AI in social studies courses can provide students with personalized, efficient and effective learning experiences. AI technologies and applications that can be used in social studies education allow students to create learning methods and plans appropriate to their personal levels and learning styles (İncemen & Öztürk, 2024, p.30). In this way, projects can be developed or individualized programs can be implemented by taking into account students' readiness levels.

To give examples of AI applications that teachers can use in the context of social studies education (Türker, 2023, p.197-200): “Lessonplans.ai” is an AI-supported lesson plan creation tool and was developed by teachers. “Gradescope” is an AI-supported grading, homework evaluation and alternative solutions to questions for higher education educators (Middle East Technical University, 2023). “Juji” is an AI-supported cognitive learning assistant tool that is referred to as a ‘chatbot’. It is empowered with social skills specific to humans and acts as an individualized assistant (Türker, 2023). “ChatGPT” helps students in almost every field and stands out as a personal assistant in problem solving, decision making, and creating individual plans (Zhai, 2022). For the use of visual materials, applications such as “Midjourney” and “DALL-E” produce visuals using AI and diffusion technology. “Knewton” offers personalized learning materials by analyzing students' strengths and weaknesses, while ‘Timemaps’ offers enriched content by visualizing history and geography concepts in the social studies course. “Watsontutor” and ‘Autotutor’ are examples of dialog-based tutorial systems (Arslan, 2020).

Metaphors are “structures that can be used by everyone in daily life and can survive in social memory and help to define and describe thoughts and perceptions” (Demir & Karakaş-Yıldırım, 2019, p. 1087). Lakoff (1993, p.202) defines the concept of metaphor as “a novel or poetic linguistic expression where one or more words for a concept are used outside of its normal conventional meaning to express a similar concept.” The basis of metaphor theory is the attempt to explain the lesser-known field by utilizing the known field (Lakoff & Johnson, 1980). Metaphors can support meaningful learning by establishing connections between different concepts and situations in education and training processes. In addition, they can attract students' attention to the lesson with effective ways of expression.

Social studies is an important course for both today's and future citizens (Yetişensoy & Rapoport, 2023). In a period when AI technology has become widespread in all areas of life, how it is perceived and understood is of great importance. In this direction, metaphors about how AI is understood can shed light on how individuals mentally make sense of this technology (Balıkçı et al., 2024). On the other hand, it can also provide us with information about the professional development processes of the participant group (Ulusoy, 2022). When the literature is examined, studies addressing the concept of AI in social studies education are limited. Yeşiltaş and Sönmez (2014) theoretically mentioned computer-based instructional material development and the concept of AI in their book. Sarı (2022) examined digital teaching techniques and the use of AI in social studies teaching. Karakuş (2023) investigated the relationship between social studies education and AI. Yetişensoy and Rapoport (2023) conducted a study on social studies and AI literacy. Yeşilyurt et al. (2024) examined the views of social studies graduate students on the concept of AI. In the literature, to our knowledge, there is no study investigating the metaphorical perceptions of pre-service social studies teachers (PSSTs) towards the concept of AI.

This study was conducted to answer the question “How are the metaphorical perceptions of PSSTs towards the concept of AI?”. In line with this question, it is aimed to answer the following sub-questions:

- 1) What are the metaphorical perceptions of first-year PSSTs towards the concept of AI?
- 2) What are the metaphorical perceptions of second-year PSSTs towards the concept of AI?
- 3) What are the metaphorical perceptions of third-year PSSTs towards the concept of AI?
- 4) What are the metaphorical perceptions of fourth grade PSSTs towards the concept of AI?

## **METHOD**

### **Research Design**

In this qualitative study, phenomenology design was used. Phenomenology focuses on the experiences of people and how their experiences are shaped in consciousness. Phenomenological research “focuses on phenomena that we are aware of but do not have an in-depth and detailed understanding of” (Yıldırım & Şimşek, 2018, p. 26). According to Patton (2014), phenomenological research focuses on how people perceive, describe, feel, judge, remember, and make sense of phenomena and how they talk about it with other people. In this study, it was aimed to reveal how pre-service social studies teachers make sense of and perceive the concept of AI, which has become an integral part of daily life.

### **Participants**

The participants of this study consists of PSSTs studying at the faculty of education of a state university in Ankara in the 2024-2025 academic year. There are 155 participants in the study group at the first, second, third, and fourth grade levels. The participants were selected on a voluntary basis using convenience sampling. “Convenience sampling is a method that researchers prefer when they cannot use other sampling methods due to reasons such as cost, time limitation or transportation difficulties” (Yıldırım & Şimşek, 2018, p.123).

### **Data Collection Tool**

“AI Metaphor Form” created by the authors of this study was used to collect data. The metaphor form consists of two parts: The first part of the form includes the name and purpose of the study and the definition of the concept of metaphor. In the second part of the form, the necessary page

layout was given for the participants to create metaphors about the concept of AI. The sentence organized for the participants to create their metaphors is as follows:

“Artificial intelligence is like/similar ..... . Because.....”

### Data Collection

The data of the study were collected face-to-face on a voluntary basis. Firstly, the definition of the concept of metaphor was given to the PSSTs. Then, more than one example of metaphor other than the concept of AI was given. Then, the PSSTs were asked to fill in the “AI Metaphor Form” prepared for this study. The participants were given 15 minutes to fill out the form. These forms filled out by pre-service teachers constituted the data source of the study.

### Data Analysis

In this study, the data collected with the metaphor form were analyzed with the content analysis developed by Saban (2009 p. 286). The analysis and interpretation of the data were carried out in five stages:

*Metaphor Coding and Sorting Phase:* First, the data obtained in the study were classified according to the grade level. Afterwards, the forms that did not fit the definition of metaphor, had no justification, were left blank, or contained only the definition of the relevant concept were excluded from the analysis. Accordingly, 39 forms were excluded from the study on the grounds that they could not be considered metaphors. Examples from each grade level that cannot be considered metaphors are given in Table 1.

**Table 1. Examples of Metaphors Extracted from this Study According to Grade Levels**

Participant Class Level	Unaccepted Metaphor Examples
Undergraduate 1st grade level	“AI women are like Ankara. Because they are both managers.”
Undergraduate 2nd grade level	“AI is like a heart of burning stone. Because some people have hearts even harder than stone.”
Undergraduate 3rd grade level	“AI is like a monster with an evil heart. Because I don't like either of them.”
Undergraduate 4th grade level	“AI is like aliens. Because they both feel dangerous.”

When the examples of metaphors in Table 1 are examined, the reasons for unaccepted metaphors include factors such as the lack of a resemblance between the metaphor topics and the PSSTs’ responses and giving irrelevant examples.

*Metaphor Coding and Sorting Phase:* As a result of this stage, the metaphor forms of 28 participants at the first grade level, 38 participants at the second grade level, 26 participants at the third grade level and 24 participants at the fourth grade level were deemed suitable for analysis. The participant forms accepted as metaphors were categorized and coded according to the grade levels and the data were entered into an Excel document.

*Category Development Phase:* At this stage, categorization was made by looking at the justifications of the metaphors. Categories were entered next to the column with the codes in the Excel program. Thus, the category was placed next to each code. This stage was conducted separately for each grade level.

*Providing Validity and Reliability Phase:* Expert opinion was consulted to determine whether the metaphors obtained represented the determined categories. As a result of the criticisms made by the expert, Miles and Huberman's (1984, p. 64) formula (Number of agreements / Total number of agreements + Disagreements) was used to calculate the intercoder reliability. Accordingly, the percentage of agreement was 92%. In the literature, a percentage of agreement of 90% and above is accepted as a high level (Saban, 2009, p. 288).

*Transferring the Data to the Computer Environment:* After all the data were transferred to the computer, the number of metaphors and the number of participants representing the determined category (*f*) were calculated. Then, the data were tabulated and supported with direct quotations and presented in the findings section.

*Findings:* At this stage, the results are reported.

## FINDINGS

In this part of the study, the metaphorical perceptions of the PSSTs towards the concept of AI are listed according to their grade levels. The metaphorical perceptions of first-year PSSTs towards the concept of AI are presented in Table 2.

**Table 2. Findings regarding the first-year PSSTs’ metaphorical perceptions towards the concept of AI**

Category	Metaphor ( <i>f</i> )	Metaphor	Participants
1. Serving to Purpose	7	Empty Room	PST2.1
		King	PST27.1
		Atomic Bomb	PST28.1
		Love	PST10.1
		Delibal	PST13.1
		Sun	PST4.1
		Poison	PST1.1
2. Diligence	1	Ant	PST16.1
3. Moving Forward	2	Imagination	PST7.1
		Leg	PST11.1
4. Communicating	4	Child with Autism	PST18.1
		Human	PST21.1, PST6.1
		Imaginary Friend	PST22.1
5. Complexity	2	Nature	PST17.1
		Universe	PST3.1
6. Problem Solving	3	The Brain	PST9.1, PST19.1, PST25.1
		Play Dough	PST20.1
7. Designing	3	The Brain	PST8.1
		Silk	PST5.1
		Electric Vehicle	PST12.1
8. Assistance Mechanism	4	Psychologist	PST15.1
		Medicine	PST24.1
		Sun	PST26.1
		Poison	PST1.1
9. Harmful	2	Poison	PST1.1
		Black Hole	PST23.1

As seen in Table 2, the first year PSSTs created 28 metaphors about AI and these metaphors were grouped under nine categories. The categories with the highest number of metaphors are “Serving to Purpose” ( $f=7$ ), “Communicating” ( $f=4$ ) and “Assistance Mechanism” ( $f=4$ ). Examples of the PSSTs’ metaphors for the concept of AI are presented below:

### Serving to Purpose Category

PST1.1. *“AI is like poison. Because it becomes useful under appropriate conditions and in the right hands. Otherwise, if the intended use is bad, it can lead to disaster.”*

PST2.1. *“AI is like an empty room. Because whatever you use it for, it serves that purpose, just like an empty room.”*

PST4.1. *“AI is like the sun. Because the sun is very important for us. It provides great benefit in terms of vitamin D. AI also provides great convenience. But just as we get burns when we stand in the sun too long, AI has negative aspects as well as positive aspects. It is necessary to use it as much as necessary. We need to know how to let go when we have achieved our goal.”*

PST28.1. *“AI is like an atomic bomb. Even if it is produced for useful purposes, it can have very dangerous consequences if misused.”*

### Communicating Category

PST18.1. *“AI is like a child with autism. Because when you understand its language and provide the right context, it will provide you with systematic and effective information. When the child with autism is given the right information, just like AI, it becomes a great source of knowledge and skills. (...) Therefore, it is essential to communicate with it correctly.”*

PST21.1. *“AI is like a human. Because it talks like a human. It listens to you and gives logical answers.”*

PST22.1. *“AI is like an imaginary friend. Because the AI in front of us is actually our product, we can talk to it and communicate with it.”*

### Assistance Mechanism Category

PST12.1. *“AI is like electric vehicles. Because both AI and electrical appliances came later and made our lives easier and helped us.”*

PST15.1. *“AI is like a psychologist. Because it is always with me, helping me, and taking care of my problems.”*

PST24.1. *“AI is like medicine. Because it saves you when you need help.”*

PST26.1. *“AI is like the sun. Because it plays a big and effective role in facilitating our daily lives. The sun also benefits us and energizes us with vitamin D. AI is useful like the sun.”*

Second-year PSSTs’ metaphorical perceptions regarding the concept of AI are presented in Table 3.

**Table 3. Findings regarding the second-year PSSTs’ metaphorical perceptions towards the concept of AI**

Category	Metaphor (f)	Metaphor	Participants
1. Serving to Purpose	7	Book	PST9.2, PST10.2
		Technological Age	PST16.2
		Assistant	PST17.2
		Glucose	PST30.2
		Cell Phone	PST36.2
		Tame Beast	PST40.2
		Relative	PST4.2, PST5.2
2. Pedantry	6	Digital Book	PST33.2
		Electronic Brain	PST34.2
		Computer	PST39.2
		Rasim Ozan Kütahyalı	PST8.2
3. Mysterious	3	Ocean	PST12.2
		Twilight	PST25.2
		Pandora's Box	PST26.2

4. Complexity	4	Intelligence Cube	PST20.2
		Knot	PST23.2
		Space Void	PST3.2
		Universe	PST7.2
5. Unpredictable	4	Politics	PST28.2
		Future	PST19.2
		Men	PST24.2
		Closed Box	PST21.2
6. Infinity	3	Space	PST29.2, ÖA37.2
		Gap	PST38.2
7. Designing	1	Play Dough	PST13.2
8. Assistance Mechanism	8	Close Friend	PST1.2, PST15.2
		Robot	PST11.2
		Robot Vacuum Cleaner	PST14.2
		Conscious human	PST18.2
		Entering the Sea	PST22.2
		The Brain	PST31.2
9. Harmful	2	Student	PST6.2
		Apocalypse	PST27.2
		Virus	PST32.2

When Table 3 is examined, it is seen that the second-year PSSTs created 38 metaphors and they were grouped under nine different categories. The categories with the highest number of metaphors are “Assistance Mechanism” ( $f=8$ ), “Serving to Purpose” ( $f=7$ ) and “Pedantry” ( $f=6$ ). Some of the examples of the PSSTs’ metaphors for the concept of AI are presented below:

#### **Assistance Mechanism Category**

PST1.2. *“AI is like a close friend. Because it does not withhold its support and help in every subject, it searches, finds and responds to everything when needed.”*

PST11.2. *“AI is like a robot vacuum cleaner. Because it helps us, it makes our lives easier.”*

PST14.2. *“AI is like a robot. Because like a robot, it does what we want and helps us.”*

PST15.2. *“AI is like a best friend. Because best friends can reveal your thoughts about yourself. They always support, help, and stand by you.”*

PST18.2. *“AI is like a conscious person. Because it helps us like a conscious human being.”*

PST31.2. *“AI is like the brain. Because it does things that humans cannot do and cannot reach. It helps and completes the human.”*

#### **Serving to Purpose Category**

PST9.2. *“AI is like a book. Because in a book, everyone learns information according to their own purpose. AI is like that. People learn the information they need from it.”*

PST10.2. *“AI is like a textbook. Because they both contain many subjects. Everyone chooses a subject for their goal and learns. Both provide information.”*

PST30.2. *“AI is like glucose. Because although glucose is necessary for energy in our body, if we take too much of it, it is harmful. We need to take as much as we need. AI is the same way. (...)”*

PST36.2. *“AI is like a cell phone. Because when we use AI for good things in our lives, the results will be good. If we use it for evil, it will have bad consequences. A cell phone is also useful if we use it for good. (...)”*

PST40.2. *“AI is like a docile monster. Because if it is used ethically where necessary, it is very docile and useful, but if it is used for dangerous purposes, it is a dangerous monster.”*

### **Pedantry Category**

PST4.2. *“AI is like relatives. Because they have opinions about everything. So is AI.”*

PST33.2. *“AI is like an electronic brain. Because it knows things that the human brain cannot know, it knows everything and does it digitally.”*

PST34.2. *“AI is like a digital book. Because in the past, people used to use books to find answers to their questions. But today, people access all information through AI and ask their questions to it. AI has become an omniscient digital book.”*

The third year PSSTs’ perceptions towards the concept of AI are presented in Table 4.

**Table 4. Findings regarding the third-year PSSTs’ metaphorical perceptions towards the concept of AI**

Category	Metaphor ( <i>f</i> )	Metaphor	Participants
1. Serving to Purpose	4	Weapon	PST28.3
		Medicine	PST14.3
		Plastic	PST26.3
		Rain	PST9.3
2. Knowledge Transfer	4	Speed of Light	PST15.3
		Book	PST16.3
		Internet	PST27.3
		Encyclopedia	PST4.3
3. Developing	6	Seed	PST13.3
		Human	PST18.3
		Science Fiction Movie	PST23.3
		Marriage	PST29.3
		Rocket	PST10.3
		Ivy	PST24.3
4. Infinity	2	Space	PST25.3
		Road	PST3.3
5. Assistance Mechanism	9	Friend	PST1.3
		Sister	PST11.3
		Maid	PST17.3
		Robot	PST19.3
		Shoe Puller	PST2.3
		Car	PST5.3
		Money	PST6.3
		Mother	PST7.3
		Walnut	PST8.3
6. Harmful	1	The Virus	PST12.3

When Table 4 is examined, it is seen that third-year PSSTs created 26 metaphors about the concept of AI and these metaphors were grouped under six different categories. The categories with the highest number of codes are “Assistance Mechanism” ( $f=9$ ), “Developing” ( $f=6$ ), “Serving to Purpose” ( $f=4$ ), and “Transferring Knowledge” ( $f=4$ ). Some of the metaphors in these categories are given below:

### **Assistance Mechanism Category**

PST1.3. *“AI is like a friend. Because it is with you when you need it, it runs to help you.”*



PST5.3. *“AI is like a car. Because it helps make our lives easier.”*

PST7.3. *“AI is like a mother. Because it answers our questions and helps us with things we don't want to do, can't do or don't know.”*

PST11.3. *“AI is like a big sister. Because it helps you with your homework and is always there for you when you get stuck.”*

PST17.3. *“AI is like a servant. Because it does everything we want it to do for us, it helps and serves people.”*

**Knowledge Transfer Category**

PST4.3. *“AI is like encyclopedias. Because encyclopedias have a lot of information. So is AI. They inform us (...)”*

PST16.3. *“AI is like a book. Because we can find the information we want in it.”*

PST27.3. *“AI is like the internet. Because you can find things quickly.”*

**Developing Category**

PST13.3. *“AI is like a seed. Because seeds always grow and develop from the moment they are first planted. AI also continues its development from the moment it emerged.”*

PST18.3. *“AI is like a human being. Because just like a human being, it will develop over time, and reach a certain maturity.”*

PST23.3. *“AI is like science fiction movies. Because both are constantly evolving and renewing.”*

PST29.3. *“AI is like marriage. Because both are difficult to understand at first. As you develop and understand, they become enjoyable.”*

Fourth-year PSSTs’ metaphorical perceptions regarding the concept of AI are presented in Table 5.

**Table 5. Findings regarding the fourth-year PSSTs’ metaphorical perceptions towards the concept of AI**

Category	Metaphor (f)	Metaphor	Participants
1. Serving to Purpose	2	Octopus	PST18.4
		Mushroom	PST19.4
2. Dependent	1	Rotring Pen	PST6.4
3. Developing	1	Human Body	PST26.4
4. No Feelings	1	Tasteless Food	PST13.4
5. Complexity	2	The Brain	PST8.4, PST14.4
6. Infinity	3	Ocean	PST16.4, PST23.4
		Endless Page Book	PST15.4

		Psychologist	PST10.4
		Sun	PST11.4
		Washing Machine	PST17.4
		Super Hero	PST2.4
		Remote Control	PST20.4
		Maid	PST22.4
7. Assistance Mechanism	13	Automatic Gear Car	PST24.4
		Teacher	PST25.4
		Octopus	PST3.4
		Lifeguard	PST4.4
		Kettle	PST5.4
		Speed of Light	PST7.4
		Book	PST9.4
8. Harmful	1	Silence Before the Apocalypse	PST1.4

When Table 5 is examined, it is seen that fourth-year PSSTs created 24 different metaphors about the concept of AI and these metaphors were grouped under eight categories. The categories with the highest frequencies are “Assistance Mechanism” ( $f=13$ ) and “Infinity” ( $f=3$ ). Some of the examples of the PSSTs’ metaphors for the concept of AI are presented below:

#### **Assistance Mechanism Category**

PST2.4. *“AI is like a superhero. Because it helps and saves us when we need it.”*

PST3.4. *“AI is like an octopus. Because it has so many arms, whatever we ask, it immediately runs to help. It reaches everything like an octopus.”*

PST4.4. *“AI is like a lifesaver. Because it helps us every time we get stuck.”*

PST9.4. *“AI is like a book. Because it helps us with its knowledge, it tells or writes everything.”*

PST10.4. *“AI like a psychologist. Because I share my problems with it and get supportive answers.”*

PST17.4. *“AI is like a washing machine. Because we do laundry even when there is no washing machine. With a washing machine, we don't get tired and our work is done quickly. AI is also like that, things get done even when it is not there, but its presence helps us a lot and provides convenience.”*

PST25.4. *“AI is like a teacher. Because it helps us and teaches us what we don't know.”*

#### **Infinity Category**

PST15.4. *“AI is like a book with endless pages. Because it is like the sum total of all the books in the world. It is like a huge book that covers all the topics in the world (...)”*

PST16.4. *“AI is like the ocean. Because all kinds of information can be accessed. It is endless, endless.”*

PST23.4. *“AI is like the ocean. Because it is vast like an infinite space.”*

#### **No Feelings Category**

PST13.4. *“AI is like a tasteless meal. Because it can never feel what a human feels, and it cannot replace it.”*

## CONCLUSION AND DISCUSSION

This study, which aims to determine how the concept of AI appears in the perceptions of the PSSTs, was completed with 155 participants. As a result of the analysis of the metaphors developed by the PSSTs, 116 metaphors accepted as valid were categorized. According to the results of the analysis, Assistance Mechanism ( $f=34$ ), Serving to Purpose ( $f=20$ ), Complexity ( $f=8$ ), Infinity ( $f=8$ ) and Harmful ( $f=6$ ) were the most frequently produced metaphors by the participants. On the other hand, the metaphor categories produced in common at all grade levels from first to fourth grade were Assistance Mechanism ( $f=34$ ), Serving to Purpose ( $f=20$ ), and Harmful ( $f=6$ ).

When the metaphors produced by the PSSTs under the category of 'Assistance Mechanism' were examined, it was found that metaphors were produced with different concepts such as 'electric vehicle, psychologist, medicine, sun, friend, robot, robot vacuum cleaner, conscious person, going to the sea, brain, student, sister, maid, shoehorn, car, money, mother, walnut, washing machine, superhero, remote control, automatic gear car, teacher, octopus, lifeguard, kettle, speed of light and book'. In these metaphors, it is seen that the concept of AI emphasizes the features of making human life easier and helping when needed. A review of the literature revealed that similar findings were found in previous studies conducted in different fields. Erdoğan and Bozkurt (2023) examined pre-service physics teachers' perceptions of AI and found that pre-service physics teachers similarly evaluated AI in the category of helping people. In the study completed by Mart and Kaya (2024), it was determined that preservice preschool teachers associated the concept of AI with concepts such as technology and convenience. In the study conducted by Yeşilyurt et al. (2024), the concept of AI was explained by the participants with the category of facilitating human life. It can be said that the findings we obtained in the study are compatible with previous studies (Erdoğan & Bozkurt, 2023; Mart & Kaya, 2024; Yeşilyurt et al., 2024). In the study completed by Gündüz-Hoşgör et al. (2023), it was determined that health studies explained the concept of AI by associating it with diseases.

When the metaphors created by the PSSTs under the category of 'Serving to Purpose' were examined, it was found that metaphors were produced with different concepts such as 'empty room, king, atomic bomb, sun, poison, glucose, weapon, mushroom, love, medicine, plastic'. In these metaphors, pre-service teachers emphasized the purpose and dose of the concept of AI. According to the mental images of the PSSTs, the purpose of using AI is effective in characterizing it as good or bad.

When the metaphors produced by the PSSTs for the "Complex" category are examined, it is seen that they used the concepts of "nature, universe, intelligence cube, knot, space cavity and brain". In these metaphor images, it was seen that the participants emphasized that the concept of AI has a complicated system and is difficult to understand. When the metaphors produced by the PSSTs for the category of "Infinity" are examined, it is seen that they used the concepts of "space, void, road, ocean and endless page book". In these metaphor images, it was determined that the participants emphasized that the concept of AI fulfills a large number and variety of tasks unlimitedly. In the study conducted by Erdoğan and Bozkurt (2023) with prospective physics teachers, it was found that the concept of AI was explained with the category of infinity.

When the metaphors created by the PSSTs for the category of "Harmful" are examined, it is seen that they used the concepts of "poison, black hole, apocalypse, virus and silence before the apocalypse". In these metaphor images, it was determined that the participants emphasized that the concept of AI poses a security threat, is difficult to control, and is open to the production of false information. Similarly, in the study completed by Demir-Dülger and Köklü (2023), it was determined that teachers and administrators had concerns about AI in terms of security and ethical violations. Köken and Balaban-Dağal (2024) found that mothers had various concerns about AI. Avcı and Günay (2024) examined the attitudes of PSSTs towards AI and found that while most of the participants saw AI applications useful, they had some concerns about ethical concerns and harming humanity. It can be said that PSSTs' concerns about the concept of AI are similar to the findings of previous studies in the literature. Öcal et al. (2020) examined the views of medical faculty students on the concept of AI.

Accordingly, it was determined that most of the students' concerns about AI were gathered under the title of labor force. In our research, it was found that the PSSTs did not have any concerns about the workforce in their perceptions.

One of the important findings of this study is that the concept of AI is generally perceived positively in the mental images of pre-service teachers. It can be said that the metaphors produced in the categories of Diligence, Moving Forward, Problem Solving, Designing, Help Mechanism, Knowledge Transfer, Developing are in this direction. In other words, approximately 65% of the metaphors produced by the participants were directly produced with positive image expressions. When the literature was reviewed, similar findings were found in previous studies. Demir-Dülger and Gümüşeli (2023) found that teachers and school principals generally had positive views on AI. Balıkçı et al. (2024) aimed to determine the perceptions of teachers towards the concept of AI with metaphors. According to the results of the research, AI facilitates the work of teachers. Salur (2023) determined the perceptions of pre-service social studies teachers about the concept of digitalization with metaphors. In the study, it was determined that pre-service teachers emphasized that digitalization makes life easier and guides people.

Another important finding obtained in the research is that the concept of AI has a negative position in the mental images of some pre-service teachers. It can be said that the metaphors produced especially in the categories of Complexity, Harmful, Pedantic, Mysterious, Unpredictable, Dependent, Deprived of Feelings are in this direction. In terms of negative perception, the participants who continue their education in the second grade produced the most metaphors ( $f=19$ ). The least number of metaphors in terms of negative perception was produced by the participants in the third grade ( $f=1$ ). Yeşilyurt et al. (2024) conducted a study with social studies graduate students and found that the participants had both positive and negative perceptions towards the concept of AI. In the aforementioned study, it was determined that ethical violations and privacy issues came first among the concerns of graduate students. Participants also mentioned that AI could pose threats to the labor force potential and be open to manipulation. Similarly, there are studies in the literature where participants have both positive and negative perceptions towards AI (Balıkçı et al., 2024; Çam et al., 2021; Çetin & Aktaş, 2021; Erdoğan & Bozkurt, 2023).

In this study, it was also determined that metaphors in different categories were explained with the same concepts in the mental images of pre-service teachers. For example, the concepts of sun and medicine were used in metaphors representing both the categories of Serving to Purpose and Help Mechanism. Again, the concept of human was used in metaphors representing both the Communication and Developing categories. The concept of brain was used in the categories of Designing, Problem Solving, Complexity and Help Mechanism. Likewise, the concept of poison was used both in the category of Serving to Purpose with its feature of use in dosage and in the category of Harming because of its feature of harming.

The results of this study showed that the PSSTs have a positive perception in their mental images of the concept of AI. According to the findings obtained from the study, the following suggestions can be made:

- This study was completed with the participation of 155 pre-service teachers. There is a need for more extensive and comprehensive research on the concept of AI.
- The factors affecting the PSSTs' perceptions regarding the concept of AI can be investigated through qualitative research. Especially, the reasons why the PSSTs produce negative metaphors can be investigated in future studies.
- In addition, the PSSTs' perceptions of AI tools can be investigated in more detail through longitudinal studies.

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