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Metaphorical Perceptions of Middle School Students Regarding the Concept of Artificial Intelligence

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ABSTRACT

Artificial intelligence and technologies have started to directly affect and steer humanity with the developments in science and technology in recent years. Artificial intelligence is like a living organism that thinks, decides and remembers for humans. The effects and consequences of this situation on individuals and societies are explicitly predicted and observed. However, how these results will affect our future in the long term remains a big question mark. It seems likely that countries will add artificial intelligence and coding literacy skills to their curricula in order to raise awareness of their citizens in the face of these possible questions and problems in the coming years. Nowadays, understanding artificial intelligence is key to using technology effectively. Students' perceptions of this concept is crucial because of this. This present study aimed to determine the metaphorical perceptions of middle school students about the concept of artificial intelligence. Also, it is a qualitative study with phenomenological design principles. The study group consisted of 86 students studying in the 5th, 6th, 7th and 8th grades of a private school affiliated to the Ministry of National Education (MoNE) of the Republic of Turkey. The students were asked to complete the sentence "Artificial intelligence is like... because...". The data obtained from the research were analyzed by content analysis method. As a result of the research, it was determined that middle school students developed 51 different metaphors about the concept of artificial intelligence. It was found that these metaphors developed by the students were diverse and creative. The most frequently used metaphors are human (10), brain (8), robot (4), technology (3) and scientist (3). The metaphors developed by the students about the concept of artificial intelligence were separated in 4 different categories. These categories are technical/object, human/subject, nature-related and interesting/other. Middle school students perceived the concept of artificial intelligence mostly through human subjective elements. In addition, it was observed that students perceived the concept of artificial intelligence in a very broad perspective.

Key words: Artificial Intelligence, Education, Middle School Students, Metaphorical Perception

INTRODUCTION

The definition and scope of the concept of artificial intelligence are changing along with advancements in science and technology. British logician and mathematician Alan Turing's fundamental question dating back to 1950, "Can a machine think?" laid the foundations of artificial intelligence (Zafari et al., 2022). McCarthy first used the concept of artificial intelligence in 1956 (Russel & Norvig, 2010). "Artificial intelligence is the science and engineering of making intelligent machines, especially intelligent computer programs" (McCarthy, 2007). Artificial intelligence is the ability of a digital computer or a computer-controlled robot to perform tasks usually associated with intelligent beings. The term is often used to refer to developing systems equipped with intellectual processes typical of humans, such as reasoning, discovering meaning, generalizing, or learning from past experience (Britannica, 2023).

Artificial intelligence may bring to mind a supercomputer. A computer with enormous processing capabilities, including adaptive behavior. Artificial intelligence is able to interact thanks to its functional capabilities that enable it to have relatively human-like cognition (Chen et al., 2020). However, while human intelligence can make perfect decisions, machine intelligence can only make one of the defined decisions. In other words, decisions that humans can make creatively are missing in artificial intelligence (Ghosh et al., 2018). Human intelligence is superior to artificial intelligence, but artificial intelligence can work much faster than the human brain when rapid change of phenomena, complexity, and many tasks need to be solved simultaneously (Teng, 2019). It has unique possibilities and new generation

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systems that human trainers do not have. These opportunities should be utilized to support learning anytime, anywhere, by anyone (Roll & Wylie, 2016). Thus, the question is, does artificial intelligence have a limit? We can best answer this question by comparing artificial intelligence with human intelligence. Today, while human intelligence and its limits are not yet fully known, determining the limits of artificial intelligence is an unscientific approach.

Artificial intelligence directs our lives with high-level cognitive skills such as perception, learning, decision-making and inference. In a few years, it is expected that artificial intelligence will facilitate the lives of humanity by undertaking many jobs and can be much more active than us (Çetin & Aktaş, 2021). In such a situation, the importance of being an artificial intelligence literate is increasing. According to Edward Fredkin (1993), the emergence of artificial intelligence is one of the three important events in history. In line with the literature and definitions related to the concept of artificial intelligence, artificial intelligence is a set of software-based systems that direct the working principles of man-made machines with rapid developments in science and technology and are used in the production, development and dissemination of information.

Artificial intelligence ideally improves intelligent behaviors in computers that imitate human behavior. It is used in science, technology and engineering fields as well as in education (Naqvi, 2020). Today, as a result of the impact of artificial intelligence on many fields and sectors, its impact on individual and social life is increasing and therefore it is more researched. Artificial intelligence directs especially smartphones, internet, search engines and various applications (Shulman & Bostrom, 2012). It directly affects many fields such as health, trade, energy, transport, security and education. Significant studies are being carried out by governments to understand and develop artificial intelligence. Countries such as the USA, China, the United Kingdom, Finland and Korea inform students about the basic principles and use of artificial intelligence in school curricula (Paek & Kim, 2021).

Artificial intelligence used in education is related to computer programs that perform cognitive tasks related to the human mind, especially learning and problem solving (Baker et al., 2019). Educational technologies and digital learning tools are programmed through artificial intelligence. In the 21st century, artificial intelligence software is used in the development of both national digital education portals of countries and digital learning platforms developed by private companies. Studies on the introduction and adoption of artificial intelligence in higher education policies and new technologies in education and training have increased especially in recent years (Taşçı & Çelebi, 2020). The Digital Transformation Office established under the Presidency of the Republic of Turkey carries out projects on artificial intelligence with science and education institutions such as the Ministry of National Education, TÜBİTAK, YÖK and universities (Tamer & Övgün, 2020). In line with the 2023 targets of the Ministry of National Education, it is aimed to use artificial intelligence applications effectively in education (İşler & Kılıç, 2021).

With the use of artificial intelligence in the field of education, digital, innovative and effective learning tools have been developed in line with the needs of the age. In this respect, artificial intelligence is expected to improve knowledge and skill-based processes in learning. It is possible to see the effect of artificial intelligence in various stages of children's lives from their everyday routines and school lives. Artificial intelligence will affect almost every aspect of life in the near future and children will be the most affected. Artificial intelligence harbors some risks as well as the opportunities it provides (Saçan et al., 2022). Literacy is typically used to describe a set of abilities in writing or abstract thought. But now that coding and artificial intelligence have entered our daily lives, some numerical abilities can be referred to as literacy. In such a situation, it is predicted that artificial intelligence and coding literacy skills will be on the agenda in the near future, especially in middle school curricula. Mankind should focus on developing the skills of using and managing artificial intelligence. With the increase in epidemics and natural disasters that pose a threat to humanity in recent years, it is important to plan education systems on the axis of artificial intelligence (Coşkun & Gülleroğlu, 2021).

Artificial intelligence has the potential to provide teachers with feedback on the success of their students. Some schools use artificial intelligence systems to monitor students' progress (Fahimirad & Kotamjani, 2018). Luckin et al. (2016) state that there are three categories of AI software in today's education. These are: a) personal tutors, b) intelligent support for collaborative learning, c) intelligent virtual reality. Personal tutors, i.e. personalized learning systems and predictive analytics tools, are increasingly being deployed in educational environments (Holmes et al., 2019). Thanks to this adaptive education, it is ensured that each student learns according to his/her mental level and abilities (Ahmad et al., 2022). Applications and tools guided by artificial intelligence technologies, such as smart robots and adaptive learning systems, are increasingly preferred by educational institutions, teachers and students (Chen et al., 2020). For this reason, it is very important to determine the metaphorical perceptions of middle school students towards the concept of artificial intelligence.

A significant portion of the studies on artificial intelligence are on the use of artificial intelligence in education (Akgun & Greenhow, 2021; Arslan, 2020; Chen et al., 2020; Coşkun & Gülleroğlu, 2021; Çam et al., 2021; Fahimirad & Kotamjani, 2018; İşler & Kılıç, 2021; Lameras & Arnab, 2021; Nalbant, 2021; Paek & Kim, 2021; Zawacki-Richter et al., 2019; Roll & Wylie, 2016; Zafari et al., 2022). Aktaş (2021) examined the views of administrators and teachers on artificial intelligence and concluded that both participant groups mostly perceived artificial intelligence as a "mechanical structure" and did not have sufficient and accurate information about artificial intelligence. In a study conducted by Saçan et al. (2022) investigating children's metaphorical perceptions of the concept of artificial intelligence, it was determined that children produced 12 metaphors. These metaphors were grouped under 2 main themes: living and non-living.

This current study aims to determine the metaphorical perceptions of middle school students towards the concept of artificial intelligence. In line with this purpose, answers to the following questions were sought.

1. Which metaphors do middle school students use to explain their perceptions of the concept of artificial intelligence?
2. Through which categories are middle school students' metaphors for the concept of artificial intelligence explained?

METHOD

Research Design

This is a qualitative study designed according to phenomenological research design. In phenomenological research, the cognitions and experiences of a person or persons about a phenomenon are addressed (Johnson & Christensen, 2012). Phenomenological research defines the common meaning of the experiences of several people about a phenomenon or concept (Creswell, 2015). Phenomenology focuses on phenomena that we are aware ofbut lack extensive knowledge and cannot form a clear perspective. These phenomena can be experiences, perceptions, orientations, concepts and situations (Yıldırım & Şimşek, 2013). In this study, phenomenology design was used since it was aimed to determine the perceptions of middle school students towards the concept of artificial intelligence using metaphors.

Study Group

The study group of the research consists of 86 students studying in the 5th, 6th, 7th and 8th grades of a private school affiliated to the Ministry of National Education (MoNE) of the Republic of Turkey in the 2022-2023 academic year. Criterion sampling method, one of the purposeful sampling methods, was used to determine the study group. The basic understanding of this sampling method is to study situations that meet a set of predetermined criteria (Yıldırım & Şimşek, 2013). In this study, the criterion is an educational institution where training and seminars on coding and artificial intelligence are given.

Data Collection Tool

Artificial intelligence metaphorical perception form prepared by the researcher was used to collect the research data. The form prepared at the data collection stage was distributed to the students in the classroom after informing about the purpose of the research. The students were asked to complete the sentence "Artificial intelligence is like... because...". The data obtained from this form is the main data source of the research. The expression "such as" in the artificial intelligence metaphorical perception form is expected to establish a connection between the source and the subject of the researched concept, and the expression "because" is expected to provide a justification for the metaphors created (Saban, 2008).

Data Analysis

The data obtained from the research were analyzed by content analysis method, one of the qualitative analysis types. Content analysis is a set of methodological tools and techniques. These tools and techniques can be characterized as a controlled interpretation effort and a deductive "reading" tool. Content analysis technique is based on inference (Bilgin, 2014). Similar metaphors created by the students were brought together and categories were formed. The number of categories created by the researcher varies according to the data and the focus of the research, but in any case, this number should be controllable. This is because as the number of categories decreases, a higher level of abstraction is achieved (Merriam, 2013). In order to ensure the reliability of the research, expert opinion was consulted and the research data were evaluated in detail. Afterwards, the agreement between the evaluators was analyzed. Inter-rater reliability was calculated using the formula (agreement / (agreement + disagreement) × 100) (Miles & Huberman, 1994) and the reliability was found to be 95%. In addition, the validity of the research was increased by using direct quotations from the students in the findings section.

FINDINGS

In this section, the metaphors created by the middle school students about the concept of artificial intelligence are tabulated and presented in a way to include categories, frequency values and sample metaphors. In addition, demographic information including the participants' coding training status, gender, age, and grade level are given.

In Table 1, the coding education and demographic information of the middle school students participating in the study are presented. Seventy-one of the participants (82.6%) stated that they received coding training, while 15 (17.4%) stated that they did not receive coding training. It was found that the level of coding education of the middle school

Table 1. Demographic information of participants

Information of Participants	*f*	%
Coding Training		
Yes	71	82.6
No	15	17.4
Gender		
Female	36	41.9
Male	50	58.1
Age		
10 years old	8	9.3
11 years old	23	26.7
12 years old	30	34.9
13 years old	20	23.3
14 years old	5	5.8
Class Level		
5. Classroom	16	18.6
6. Classroom	32	37.2
7. Classroom	16	18.6
8. Classroom	22	25.6
Total	86	100.0

students participating in the study was high. Of the students, 36 (41.9%) were female and 50 (58.1%) were male. It was determined that the participants were between the ages of 10-14, 8 (9.3%) were 10 years old, 23 (26.7%) were 11 years old, 30 (34.9%) were 12 years old, 20 (23.3%) were 13 years old and only 5 (5.8%) students were 14 years old. Students at all grade levels from 5th to 8th grade were included in the study. 16 (18.6%) students in 5th grade, 32 (37.2%) students in 6th grade, 16 (18.6%) students in 7th grade and 22 (25.6%) students in 8th grade participated in the study.

When Table 2 is examined, it is seen that the middle school students developed a total of 51 different metaphors about the concept of artificial intelligence. It can be said that these metaphors developed by the students are diverse and creative. These metaphors generally have abstract meaning. The most frequently used metaphors by students are human (10), brain (8), robot (4), technology (3) and scientist (3).

In the metaphors made by the middle school students, it was determined that they generally approached the concept of artificial intelligence from a high-level perspective and explained artificial intelligence by relatively perfecting it. The metaphors in Table 2 were categorized in 4 different categories. These categories are technical/object (11), human/subject (20), nature-related (7) and interesting/other (13).

Technical/Object Category

Of the 51 different metaphors perceived by the middle school students about the concept of artificial intelligence, 11 are in the technical/object category. The metaphors under this category and sample analogies are shown in detail in Table 3.

As seen in Table 3, there are 11 different metaphors in the technical/object category. Middle school students also perceived the concept of artificial intelligence in technical terms. Under this category, there are technology, robot, zero in absolute value, internet, intelligence of technology, artificial brain, realism, brain that does not make mistakes, coding, machine, and information metaphors. Accordingly, one of the most prominent features perceived by students about the concept of artificial intelligence is that it is a technical concept. The metaphors in this category show more concrete features than the metaphors in the category related to nature. The students likened the concept of artificial intelligence to technology with the explanation "it is unknown what will happen in the future", to zero in absolute value with the explanation "it has, positive and negative aspects", to a brain that does not make mistakes with the explanation "it evaluates everything and finds the best result", and to a machine with the explanation "it is the best and very fast". It was

Table 2. Metaphors formed by middle school students regarding the concept of artificial intelligence

Metaphor	*f*	%	Metaphor	*f*	%
1. Bad films	1	1.16	27. Assistant	1	1.16
2.Technology	3	3.48	28. Root of the tree	1	1.16
3. Robot	4	4.65	29. Footballer	2	2.32
4. The lower level of the human mind	1	1.16	30. The end of humanity	1	1.16
5. Zero in absolute value	1	1.16	31. Medicine	2	2.32
6. Versatile	1	1.16	32. Witty human	1	1.16
7. Internet	1	1.16	33. Superhuman intelligence	2	2.32
8. The intelligence of technology	1	1.16	34. High level world	1	1.16
9. Brain	8	9.30	35. Chocolate	1	1.16
10. Artificial brain	2	2.32	36. Ferris wheel	1	1.16
11. The reason for the brainless generation	1	1.16	37. Growing flower	1	1.16
12. Human	10	11.6	38. Football	1	1.16
13. Book	2	2.32	39. Knowledge	1	1.16
14. One of us	1	1.16	40. Friend	1	1.16
15. An empty brain	2	2.32	41. Scientist	3	3.48
16. A clever one	2	2.32	42. Germ	1	1.16
17. Heroic mum	1	1.16	43. Evolution	1	1.16
18. Assistant	2	2.32	44. Slave	1	1.16
19. Realism	2	2.32	45. Transition to different dimensions	1	1.16
20. The brain that makes no mistakes	1	1.16	46. New life	1	1.16
21. Baby/child	1	1.16	47. Super intelligence	2	2.32
22. Life	2	2.32	48. Money	1	1.16
23. Complementary important project	1	1.16	49. Part of our life	1	1.16
24. Mother and father	1	1.16	50. Coding	2	2.32
25. More than human intelligence	1	1.16	51. Machine	1	1.16
26. Aliens	1	1.16			

Table 3. Metaphors in the technical/object category

Category	Metaphor	Example Analogy
Technical/ object	Technology	*The future is unknown (F3)*
	Robot	*Robots are technological tools (F62)*
	Zero in absolute value	*There are pros and cons, i.e., positive and negative (F6)*
	Internet	*Useful for everything (F15)*
	The intelligence of technology	*As the name suggests, artificial intelligence is something that has been touched by human hands (F9)*
	Artificial brain	*It is not real, it is artificial (F11)*
	Realism	*It will be artificial in the future (F24)*
	The brain that makes no mistakes	*Evaluates everything and finds the best result (F25)*
	Coding	*Figures prevail (F85)*
	Machine	*The best is very fast (F57)*
	Information	*We research and learn what we do not know (F55)*

determined that there was a linear relationship between the metaphors used here and the directions of analogy.

Since artificial intelligence is mostly related to the software side of machines and smart devices, it was also explained using abstract metaphors such as coding, information, and internet.

Human/Subject Category

Of the 51 different metaphors perceived by the students about the concept of artificial intelligence, 20 are in the human/subject category. The metaphors under this category and sample simile directions are presented in detail in Table 4.

Table 4 shows that there are 20 different metaphors in the human/subject category. Middle school students mostly explained the concept of artificial intelligence with human elements. It is seen that the most metaphors are in this category. In the human/subject category, there are metaphors such as the lower level of the human mind, brain, the reason for the brainless generation, human, one of us, an empty brain, an intelligent person, heroic mother, helper, baby/child, mother and father, more than human intelligence, assistant, football player, witty person, friend, scientist, slave, super intelligence and a part of our lives. Students perceive the concept of artificial intelligence mostly through subjective elements specific to human beings. When the metaphors in this category are analyzed, it can be clearly seen that a human characteristic or role is used. For example, mother and father, heroic mother, assistant, friend, football player, scientist, slave, witty person.

When the analogy aspects of the metaphors of heroic mother, helper, mother and father, assistant and friend are analyzed, the common features of these metaphors are that they help and guide people. Explanations such as "it helps in everything", "it guides us", "it helps people" show that artificial intelligence is also perceived positively.

Table 4. Metaphors in the human/subject category

Category	Metaphor	Example Analogy
Human/ subject	The lower level of the human mind	*It perceives and does many things like the human mind, but it can never exceed the level of the human mind (F5)*
	Brain	*It can record information like the brain (F59)*
	The reason for the brainless generation	*It thinks for us (F12)*
	Human	*Can talk (F65)*
	One of us	*Their speech and reactions are very similar to ours (F16)*
	An empty brain	*Artificial intelligence is just empty for me (F17)*
	A clever one	*Has the capacity to solve everything (F19)*
	Hero mum	*It helps with everything (F21)*
	Assistant	*It guides us (F22)*
	Infant/child	*You have to explain everything to him in a simple way and it just does what it does (F27)*
	Mum and Dad	*Can do everything like our mum and dad (F32)*
	More than human intelligence	*It can know things we don't know (F37)*
	Assistant	*Helps people (F40)*
	Footballer	*Very fast (F42)*
	Witty person	*Witty answers (F45)*
	Friend	*It helps us like a tool, but when it is used a lot, it is like a friend for most people (F56)*
	Scientist	*Intelligent and can design things (F67)*
	Slave	*We can make them do what we want (F74)*
	Super intelligence	*We produce everything from it (F77)*
	Part of our lives	*Artificial intelligence is always in our lives, we do most of our work with artificial intelligence (F84)*

When the brain, human, one of us and an intelligent person metaphors and their similarity aspects are analyzed, it can be clearly stated that explanations such as "can record information like a brain", "can speak", "its speech and reactions are very similar to us", "has the capacity to solve everything" complement each other and that students explain the concept of artificial intelligence with human-specific features.

Category Related To Nature

Of the 51 different metaphors perceived by middle school students about the concept of artificial intelligence, 7 are in

the category related to nature. The metaphors under this category and sample analogies are shown in Table 5.

As seen in Table 5, there are 7 different metaphors in the category related to nature. Students also explained the concept of artificial intelligence by using elements related to nature. In this category, life, root of the tree, high-level world, growing flower, microbe, evolution, new life metaphors are included. The metaphors in this category contain more abstract and metaphysical elements compared to the metaphors in the technical/object and human/subject categories. When the simile aspects of the growing flower, microbe and evolution metaphors are analyzed, some intangible elements related to development and change stand out. For example, with respect to the statements "what they will do is unpredictable", "because it exists in everything", "it always changes and gets better" in this category, it can be stated that students perceive the concept of artificial intelligence as non-stationary, variable and mobile, just like the elements in nature.

When the metaphors of high-level world and the root of the tree are examined; the statements "can handle all kinds of jobs" and "spans a very large area"reveal that artificial intelligence is conceptualized as perfect and perfect in the perception of middle school students.

Interesting/Other Category

Of the 51 different metaphors perceived by the students about the concept of artificial intelligence, 13 are in the interesting/other category. The metaphors in this category and sample simile directions are shown in detail in Table 6.

Table 6 shows that there are 13 different metaphors in the interesting/other category. Middle school students explained the concept of artificial intelligence by developing some unusual metaphors. In the interesting/other category; complementary important project, aliens, end of humanity, superhuman intelligence, chocolate, Ferris wheel, football, transition to different dimensions, bad films, medicine, money, versatile and book metaphors are found. Students perceived the concept of artificial intelligence in a very broad perspective.

When the metaphors in this category and their similes are analyzed, it is seen that artificial intelligence is compared to aliens "is very advanced", is compared to chocolate "develops the brain, entertains and if it is too much, it rots the teeth", it is likened to a Ferris wheel "it can break down at an unpredictable moment", and to a medicine "excessive use is harm, sufficient use means benefit and progress". It can be said that there is a linear relationship between the metaphors used and the analogies. When an abstract concept such as artificial intelligence is integrated with the characteristics of middle school students such as being creative, open to asking questions and being curious due to their age and cognitive development periods, metaphors in the category of interesting/other, unusual and imaginative metaphors have emerged.

Table 5. Metaphors found in the category related to nature

Category	Metaphor	Example Analogy
Nature related	Life	*Used in every moment of life (F28)*
	Root of the tree	*Spans a very large area (F41)*
	High-level world	*Can handle any kind of work (F48)*
	Growing flower	*It is unpredictable what they will do (F51)*
	Germ	*Because it exists in everything (F72)*
	Evolution	*It always changes and gets better (F73)*
	New life	*People build new robots every day (F76)*

DISCUSSION

In this study, which aims to determine the metaphorical perceptions of middle school students towards the concept of artificial intelligence, it was observed that a large proportion of the students participating in the research (82.6%) received coding education. In Turkey, especially as a requirement of the 21st century education approach, it can be stated that applied studies on coding/robotics and artificial intelligence have been carried out to a great extent in middle schools. Coding education aims to provide students with basic skills

Table 6. Metaphors in the interesting/other category

Category	Metaphor	Example Analogy
Interesting/ other	Complementary important project	*Completes human life (F31)*
	Aliens	*Very developed (F38)*
	The end of humanity	*If it gets out of control, humanity may cease to exist (F43)*
	Superhuman intelligence	*Can do what people cannot do (F46)*
	Chocolate	*It both develops the brain, entertains and if it is too much, it decays the tooth (F49)*
	Ferris wheel	*It can break down unexpectedly (F50)*
	Football	*Passes the ball, grows and develops by being influenced by each other (F54)*
	Transition to different dimensions	*It takes us to different places, games and information (F75)*
	Bad films	*When people use artificial intelligence negatively, it can even cause suicide (F1)*
	Medicine	*Excessive use is harm, sufficient use means benefit and progress (F44)*
	Money	*Useful in daily life (F83)*
	Versatile	*Can explain different sciences (F7)*
	Book	*Everything can be found (F14)*

such as deep learning, analytical thinking and problem solving related to 21st century skills (Sayın & Seferoğlu, 2016). It has been determined that coding education improves the problem solving skills of middle school students (Aydın, 2019). In the future, it is predicted that coding education will take more place in education curricula in the world and in Turkey (Aytekin et al., 2018). In literacy, meaning creating is a high-level mental function in addition to decoding and meaning matching (Potter, 2018). In this context, it is expected that artificial intelligence and coding literacy skills will be on the agenda all over the world in a few years and countries will include this skill in their education systems. Moreover, the study of artificial intelligence literacy is becoming a hot topic in the field of teaching digital literacy (Su et al., 2023). In this way, students' ability to think analytically and abstractly, to make quick and correct decisions, and to distinguish metaphysical concepts and phenomena can be improved.

Research has determined that a complete conceptual integrity and awareness about coding and coding education has not been achieved (Ceylan & Gündoğdu, 2018). As a result of the analyses, it was determined that students developed 51 different metaphors about the concept of artificial intelligence. It was determined that these metaphors were diverse and creative. Although a significant portion of the metaphors showed abstract features, it was determined that they generally carried concrete meanings. The most frequently used metaphors by the students are human (10), brain (8), robot (4), technology (3) and scientist (3). The metaphors developed by the students about the concept of artificial intelligence were categorized in 4 different categories. These categories are technical/object, human/subject, nature-related and interesting/other.

A study by Saçan et al. (2022), determined that children produced 12 metaphors to express the concept of artificial intelligence, and these metaphors were grouped under 2 main themes as living and non-living. The phenomena to which artificial intelligence was likened were grouped under 3 themes: humanity, intelligence and robotics. In this respect, it is similar to the categories determined in this study. The themes of humanity-oriented and robotics are similar to the human/subject and technical/object categories in our study. Aktaş's (2021) study determined that administrators frequently used robot, computer, child and assistant metaphors, and teachers frequently used robot, computer, child, machine and artificial human metaphors. In our research, similar metaphors were frequently used by middle school students. In a study by Çam et al. (2021), prospective teachers defined artificial intelligence as a structure based on human intelligence. Pre-service teachers stated that artificial intelligence technologies can be used especially in medicine and education. Today, the basic need for health and education sciences and the rapid developments in these sciences also show the importance of artificial intelligence technologies. The necessity of integrating these sectors with artificial intelligence technologies and moving them forward has been partially understood.

CONCLUSION

Middle school students perceived the concept of artificial intelligence mostly through human subjective elements. It can be stated that a human feature or role is frequently used in the metaphors developed by the students. It is thought that the fact that intelligence is basically a feature specific only to humans is effective on this result. In addition, it was concluded that middle school students approached the concept of artificial intelligence from a high-level perspective and explained artificial intelligence by perfecting it to a certain extent.

One of the most prominent features that students perceive about artificial intelligence is that artificial intelligence is a technical concept. As a result of the analyses, it was determined that the metaphors in the technical/object category showed more concrete features. The metaphors in the category related to nature contain more abstract and metaphysical elements compared to the metaphors in the technical/object and human/subject categories. In addition, students also explained artificial intelligence by using some unusual and interesting metaphors. Therefore, it can be stated that students perceive the concept of artificial intelligence in a very broad perspective.

The active use of artificial intelligence and technologies, especially in educational science, makes it crucial how all parties involved in education view this idea. It should be the basic approach for students, teachers, prospective teachers and administrators to perceive and use concepts and technologies that will guide the future of coding/robotics and artificial intelligence correctly. Today's technologies will determine the education of the future and therefore the learners of the future. In this respect, it has become important for educational science and all its stakeholders to use artificial intelligence and technologies correctly and to adapt them to education by following current developments.

The breadth and significance of artificial intelligence are demonstrated by the fact that it is understood within such a large framework. Artificial intelligence should receive more attention and study because it will shape both present and future technological advancements. It is believed that as artificial intelligence advances, educational science may potentially gain from potential advancements and breakthroughs.

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