Middle School Students' Mental Images for Artificial Intelligence

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Abstract: This study aims to examine middle school students' perceptions of the concept of artificial intelligence (AI) through visual and verbal representations. A total of 203 students were asked the question, "What is artificial intelligence? Explain and draw on the back." The data were analyzed using a phenomenological design within the scope of qualitative research methods. Students' written and drawn responses were examined through content analysis, and eight main themes were identified: robots (36%), computers (18%), smart devices (12%), brain/mind (9%), human/world-AI interaction (8%), examples of AI (10%), AI code (5%), and unmanned vehicles (2%). A semi-structured interview was conducted with one student from each category to explore how they made sense of the concept of AI. The findings revealed that students mostly conceptualized AI through tangible technological objects (e.g., robots, computers), while their awareness of more abstract elements such as coding, algorithms, and cognitive processes was limited. These results highlight the need to develop AI literacy from early ages. The study presents the students' mental models of AI and offers valuable implications for curriculum development at the middle school level.

Keywords: Artificial intelligence, Mental images, Middle school students

Introduction

The rapid advancement of educational technology in recent years has a significant impact on enhancing the teaching and learning experience (Valtonen & Mäkinen, 2022). A key breakthrough within educational technology is artificial intelligence (Mhlanga, 2023). Artificial intelligence was conceptualized by John McCarthy in 1955 and is defined as the capability of a machine to execute tasks regarded as intelligent (McCarthy et al., 1955). Kurzweil (1990) describes artificial intelligence as the craft of creating machines that can carry out functions requiring human intellect (Adıguzel et al., 2023). The study of artificial intelligence aims to develop computers and machines with intelligence akin to humans (Coppin, 2004), leading to various innovations and advancements (Chen et al., 2020). Furthermore, artificial intelligence is characterized as a branch of computer science focusing on exploring the essential nature of intelligence through a series of algorithmic methods to produce intelligent entities that resemble human cognitive abilities (Dwivedia, et al., 2021). In essence, artificial intelligence aspires to replicate the cognitive functions of the human brain, including problem-solving, decision-making, forecasting, and deduction (Aktay et al., 2023). Achieving artificial intelligence involves comprehending the workings of the human brain, as well as understanding how humans learn, make decisions, and address problems, thereby utilizing the insights from this research to develop intelligent technologies and systems (Bozic & Poola, 2023). To provide a more thorough definition, any theory, methodology, or technique that aids in examining, simulating, utilizing, and investigating human thought processes and behaviors by machines, particularly computers, may be classified as artificial intelligence (Lu,

2019). The primary aim of artificial intelligence is to develop systems that can learn, demonstrate, clarify, counsel, understand, reason, and act similarly to humans. Furthermore, executing functions such as speech recognition, mastering new skills, strategizing, and resolving issues are also integral to its goals (Bozic & Poola, 2023). Given the swift advancement of artificial intelligence, along with educational and learning technologies, its application in academia profoundly influences our learning processes (Chen et al., 2020).

Artificial Intelligence in Education

Since the 1980s, the domain of artificial intelligence in education (AIEd) has emerged as a distinct area of scholarly inquiry (Williamson & Eynon, 2020). In AIEd, two primary strategies are implemented: the creation of AI-driven tools for educational environments and the evaluation and analysis of learning processes (Holmes et al., 2019). Ouyang and Jiao (2021) identified three frameworks of artificial intelligence in education (AIEd): AI-driven, where learners are perceived as passive recipients, and AI-supported, where learners engage as partners and leaders. In the initial framework, AI acts as a facilitator and navigator of cognitive learning, with students receiving AI assistance. Conversely, in the second framework, grounded in cognitive and social constructivist theories, learners work alongside AI while it enhances their educational journey. The third framework, influenced by connectionism, allows AI to enhance learning experiences while students take charge of their own educational paths, fostering a robust collaboration among students, educators, information, and technology within the system. In this light, artificial intelligence in the educational arena is acknowledged as a potent resource that promotes innovative approaches in instructional design, technological progress, and educational research that surpass traditional teaching methodologies. This capability is believed to stem from the blending of social, cultural, economic, and pedagogical aspects (Lu, 2019).

Although the influence of AI on education remains ambiguous (Holmes et al., 2019), it harbors considerable potential to enhance learning, teaching, instructional innovations, assessment, and educational management (Chen et al., 2020). Beyond its ability to transform education, realizing beneficial educational outcomes necessitates more than merely employing sophisticated AI computational technologies (Castañeda & Selwyn, 2018). The integration of technology must be intricately associated with teaching and learning theories to direct instructional design and technological progress, particularly within AI (Bower, 2019).

Artificial intelligence education has taken its place in national curricula and has been integrated into the education systems of many countries. As Ali et al. (2021) state, countries such as the USA, the UK, China and Australia attach importance to artificial intelligence education starting from pre-school education. Considering the future effects of artificial intelligence, these countries aim for children to learn and understand this technology from an early age. However, one of the main reasons why AI is not widely included in early childhood education in the US is the concerns of educators that digital technologies may have negative effects on child development (Zhang & Aslan, 2021). These concerns raise debates about how to use digital technologies in a balanced and safe way in the education system (Gok et al., 2025).

When we look at literature we encounter many investigations regarding the use of artificial intelligence in science education. When the literature is examined, its impact in the field of education can be seen in language teaching (Tasso et al., 1992; Ciftci, 2024; Ercin - Kamburoglu, 2024; Ergun, 2024; Gucuk, 2022; Karabulut, 2024; Kemal, 2024; Ozturk, 2024; Virvou et al., 2000; Yılmaz, 2024), music education (Keles, 2024), fine arts education (Erdurmus, 2023; Ozdemir, 2024), museum education (Arslan, 2019) and mathematics education (Keles, 2007; Virvou & Trisiga, 2000; Virvou & Mondridou, 2000; ZapataRivera & Greer, 2004), science education (Yorgancı & Isık, 2019; Bor & Kucukaydın, 2021; Cam et al., 2021; Bayram & Celik, 2023; Erkoc, 2023; Erdogan & Bozkurt, 2023; Sarıoglu, 2023),. Moreover, perceptions towards the concept of AI have also been examined in various studies in the context of different demographic groups and education levels (Cetin & Baklavacı, 2024; Demir & Guraksın, 2022; Sacan et al, 2022; Demirtas & Turksoy, 2023; Tartuk, 2023; Agmaz & Ergulec, 2024; Alkan &Yıldız, 2024; Altuntas & Karabay, 2024; Arslantas & Atas, 2024; Balıkcı et al., 2024; Coskun, 2024; Gorgulu & Bayrakdar, 2024; Ericok et al., 2024; Savaskan & Ozer, 2024; Seyrek et al., 2024; Senturk & Akol -Goktas, 2024; Vatansever, 2024; Gok et al., 2025; Gunes & Yılmazlar, 2025; Isık & Kose, 2025; Imamoglu et al., 2025). Despite the increasing presence of artificial intelligence (AI) in education, there is still limited research on how middle school students perceive and represent this concept through visual and verbal forms. Since middle school years are a critical developmental stage in which abstract thinking skills and attitudes toward technology are actively shaped, understanding students' perceptions of AI holds significant importance. AI is progressively being integrated into educational contexts, creating new opportunities for personalized learning, problem-solving, and creativity; however, how students conceptualize this phenomenon remains a key question. Investigating their visual and verbal representations of AI will provide valuable insights

for developing effective pedagogical strategies, fostering digital literacy, and supporting students' critical engagement with emerging technologies. Accordingly, the purpose of this study is to examine middle school students' perceptions of artificial intelligence through both visual and verbal representations. Thus, the main research question of this study is 'How do middle school students perceive the concept of artificial intelligence (AI) through visual and verbal representations?'.

Method

The study was conducted with 203 middle school students in April and May of 2025 at two middle schools in Konya, Türkiye. The data were analyzed using a phenomenological research design within the scope of qualitative research methods (Creswell,2016). This is because phenomenological research design aims to deeply explore individuals' experiences, perceptions, and meanings related to a specific phenomenon (e.g., artificial intelligence). This approach emphasizes subjective realities based on participants lived experiences. According to Creswell (2016), the phenomenological method involves understanding how participants perceive and make sense of the experiences they have gone through and identifying the common themes among those experiences. It seeks to uncover the essential meanings by collecting in-depth data from a small number of individuals.

Data Collection Instruments

Two different methods were used to collect data in this study: Drawing AI and semi-structured interviews.

Drawing AI

The drawing technique used in this study to collect data to investigate students' perceptions of the concept of artificial intelligence (AI). The students were asked to draw and explain their concept of an AI on a piece of paper. According to the students' explanations, their drawings were analyzed based on the eight categories: robots, computers, smart devices, brain/mind, human/world-AI interaction, examples of AI, AI code, and unmanned vehicles.

Coding Procedure

To code, all drawings were numbered starting from 1 up to 203. The numbers were called as Drawing(D) number. All paper numbers were entered in a column in an Excel file in the form of D1, D2, …., D203 while all categories were entered in the rows.

Interviews

The interviewees were chosen from the students who drew and explained AI images. via face-to-face communication. Although two hundred and three students were asked to draw, only eight students selected for each category were interviewed. The semi-structure interview was conducted face-to-face.

Reliability and Validity of Data Collection Instruments

To determine the reliability of the drawing AI, two different science teachers with seven- or ten-years teaching experience entered the student number into the predetermined categories according to student drawings separately. For the different and disagreed drawings, an associate chemistry professor was consulted, and a joint decision was made. Then, finally, the science teachers and the professor evaluated the collected data according to the categories determined. The interview protocol was reviewed by the science teachers and the professor. Based on their feedback, the protocol was revised and finalized. The main question was asked by all students. Depending on their answers, the probe questions were asked.

Data Collection Process

Before the study, the students received white paper and a pencil. The students were asked to draw artificial intelligence on white paper with pencil. This process took fifteen minutes until they completed the drawings. The semi structured interviews were conducted individually; the interviews lasted approximately 5-10 minutes. All students answered the main and probe questions. To allow the students to elaborate on their answers, some of the students had to respond to the extra questions that were not included in the original interview protocol depending on their drawings.

Data Analysis

A content analysis was used to analyze the Drawing AI data in this study. This analysis was developed by Berelson in 1952. The analysis became quite popular for educational qualitative research, and Yıldırım and Simsek (2013) used the method to analyze the students' drawings in their study. To increase the trustworthiness of the research question, face-to-face interviews were conducted so that the students were able to elaborate on their AI drawings. The students were selected for the interviews by considering the AI model drawn.

Findings

The data in this study were obtained using two methods: the AI drawings and face-to-face interviews. Table 1 presents the frequency and the percentage of the students' drawings.

Table 1. The frequency and the percentage of the students' drawings

Category	N	%
Computer	38	18
Robot	75	36
Smart Device (interactive board, phone, tablet)	23	12
Brain/Mind	18	9
Human/World–AI Interaction	16	8
Examples of Artificial Intelligence	21	10
Artificial Intelligence Code	9	5
Unmanned Vehicle	3	2

Table 1 shows that more than one-third of the students (36%) represented artificial intelligence through robot drawings. Following this category, computers were drawn by 18% of the students, making it the second most frequently preferred representation. Smart devices such as interactive boards, phones, and tablets were drawn by 12% of the students, indicating that these three categories together constituted 66% of all drawings. The category "Examples of Artificial Intelligence," which includes specific AI applications (e.g., facial recognition, virtual assistants), was chosen by 10% of the students. Meanwhile, 9% of the students illustrated the concept of AI through brain- or mind-related drawings. Other categories such as human/world–AI interaction (8%) and AI code (5%) were less frequently drawn. Lastly, unmanned vehicles were depicted by only 2% of the students.

Computer

The *Computer* category was the second most frequently represented form of artificial intelligence in students' drawings, with 18% of the participants choosing to depict AI as a computer. Figure 1 illustrates two representative examples from this category. This result suggests that a significant portion of students conceptualize artificial intelligence as being embedded in or operated through computers. The widespread use of computers in both educational and daily life settings likely plays a role in this association. Students are frequently exposed to computers during classroom activities, homework, and digital learning platforms, many of which include AI-supported applications (e.g., search engines, language tools, educational games).

Interviews conducted with students revealed that many of them associate artificial intelligence directly with computers, considering them as the primary tools through which AI operate. Student 1, one of the interviewees who drew a computer, stated: "Artificial intelligence works inside the computer, and it answers questions or helps you search things, so I drew a computer." This explanation was consistent with the views of other students in this category and highlights a functional and tool-based understanding of AI among participants. The view of Student 1, which is like the other students who drew this model, is given below.

Researcher: What is artificial intelligence to you?
Student 1: Things like computers, software and robots.
Researcher: So, what do you understand when you think of artificial intelligence?
Student 1: When I think of artificial intelligence, I think of things like computers and software.
Researcher: Where do you encounter artificial intelligence in daily life? Can you give an example?
Student 1: At school, at home.
Researcher: How can we use artificial intelligence in education?
Student 1: We can do homework and projects.
Researcher: What did you want to explain in this drawing, can you explain?
Student: I drew a computer for artificial intelligence because it makes our work easier, answers questions or helps you search for things thanks to the computer and artificial intelligence works with and inside computers.
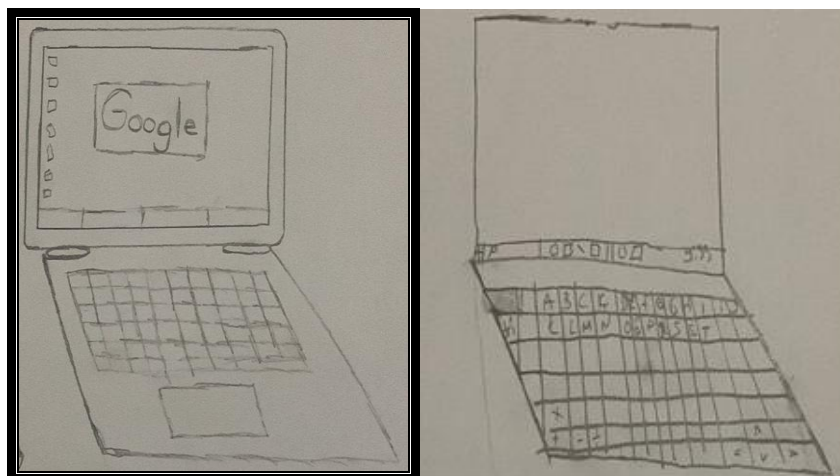

Figure 1. Examples of students' computer category

Robot

The *Robot* category was the most frequently represented theme in the students' drawings, with 36% of participants choosing to depict artificial intelligence in the form of robots. Figure 2 presents two examples of such student drawings. This finding suggests that students tend to associate artificial intelligence with humanoid or machine-like entities. The prevalence of robots in the media, including cartoons, films, commercials, and books, appears to have influenced students' mental images of AI.

Interviews conducted with selected students supported this interpretation. Many students reported that when they hear the term "artificial intelligence," the first image that comes to mind is a robot. Student 2, one of the interviewed participants who drew a robot, explained that "robots think like humans, and they can talk and do things on their own, so they must be artificial intelligence." This perspective was found to be common among other students who also represented AI with robot figures, indicating a strong media-driven association between robots and artificial intelligence in students' conceptualizations. The opinions of Student 2 about this inference are as follows.

Researcher: What is artificial intelligence in your opinion?
Student 2: AI is like a creative thought that can do extraordinary things, that can bring photos to life.
Researcher: So, what do you understand when you say artificial intelligence?
Student 2: It is something like an information robot that can help us, that can bring extraordinary things to life for us.
Researcher: Can you give examples from daily life?
Student 2: Social media and applications. For example, if we are doing a project, we can get help
Researcher: Where can we use artificial intelligence in education?
Student 2: In education, we can take notes while studying for the exam, the teacher can look from there and teach accordingly.
Researcher: What did you want to explain in this drawing, can you explain?
Student 2: Artificial intelligence is a robot that can be used in every field such as thinking like human, and it can talk and do things on its own.
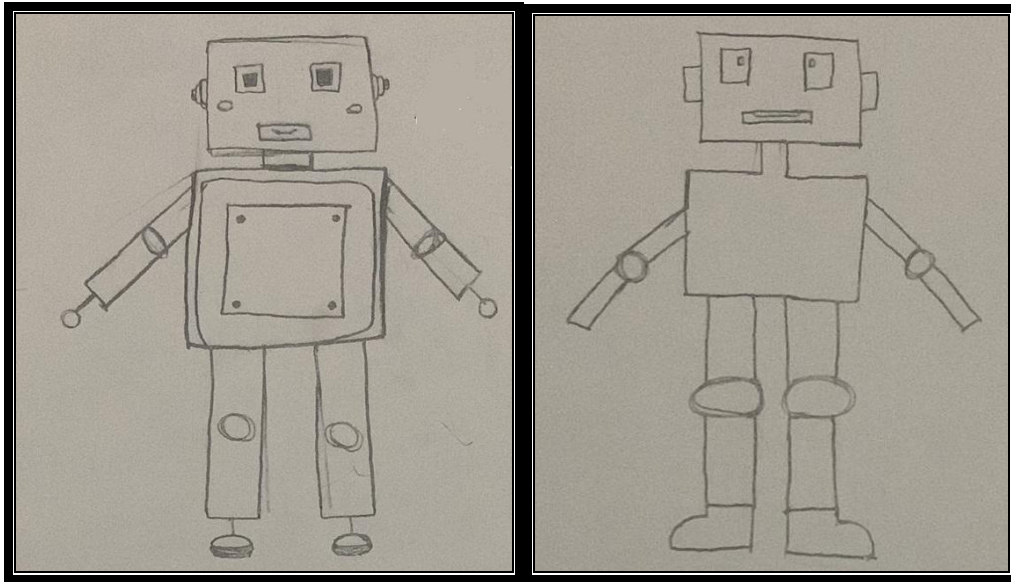
Figure 2. Examples of students' robot category

Smart Device (Interactive Board, Phone, Tablet)

The *Smart Device* category, which includes tools such as smartphones, tablets, interactive boards, and digital pencils, was chosen by 12% of the students. Figure 3 shows two examples of such students' drawings. This finding suggests that a significant number of students associate artificial intelligence with devices they frequently use in daily life, especially smartphones.
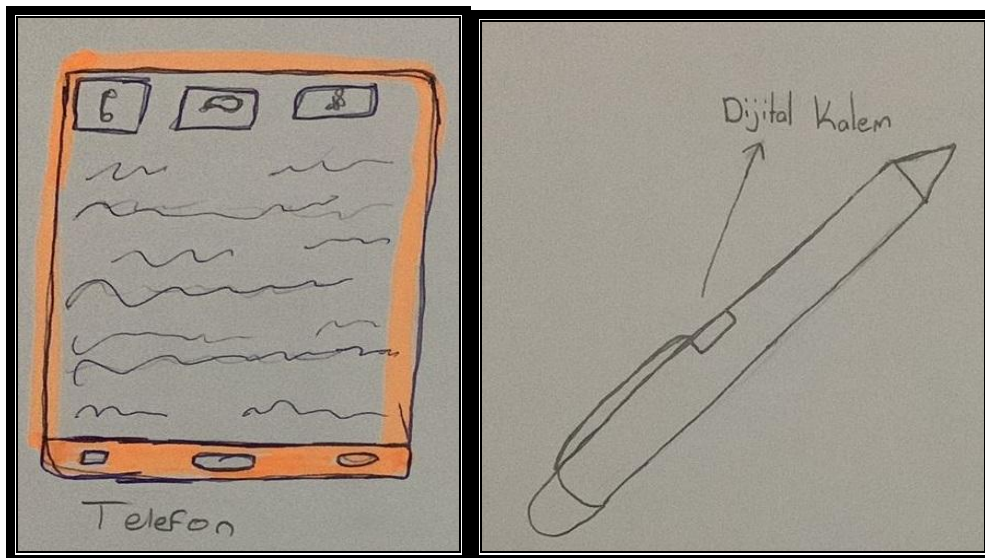

Figure 3. Examples of students' smart device category

The widespread use of smartphones among students and their frequent interaction with AI-based features—such as virtual assistants, facial recognition, or personalized suggestions—appear to influence this association. Smartphones act as a familiar interface through which students encounter artificial intelligence, often without fully understanding the complex systems behind them.

Interview responses supported this interpretation. Several students stated that they chose to draw phones because they believed that AI "exists inside" or "comes from" these devices. Student 3, who drew a smartphone with a virtual assistant feature, explained: *"When I ask something, it answers me. That's artificial intelligence, right?"* This statement demonstrates a surface-level, yet experience-driven understanding of AI as it is encountered in everyday technological interactions. The following conversation shows the opinions of Student 3 who drew the smart device.

Researcher: What is artificial intelligence to you?
Student 3: Smartphones, devices, automated devices, digital devices.
Researcher: What do you understand when you say artificial intelligence?
Student 3: Digital items, such as smartphones, computers, laptop.
Researcher: So where do we encounter artificial intelligence in daily life? Can you give an example?
Student 3: I think smartphones are the most common but sometimes the smart board.
Researcher: How can artificial intelligence be used in education?
Student 3: Thanks to the smartphone we can do homework, write poems, and do projects.
Researcher: What did you want to explain in this drawing, can you explain?
Student 3: The smartphone does our jobs, we can enter the application we want, I think artificial intelligence also talks to us on the phone, for example, when we ask something, it answers immediately.

Brain/Mind

The *Brain/Mind* category accounted for 9% of students' drawings, making it one of the more conceptually oriented representations of artificial intelligence. Figure 4 displays two examples from this group. These drawings typically included images of human brains, neural connections, or thought symbols, suggesting that some students perceive artificial intelligence as a thinking or cognitive system like the human mind.
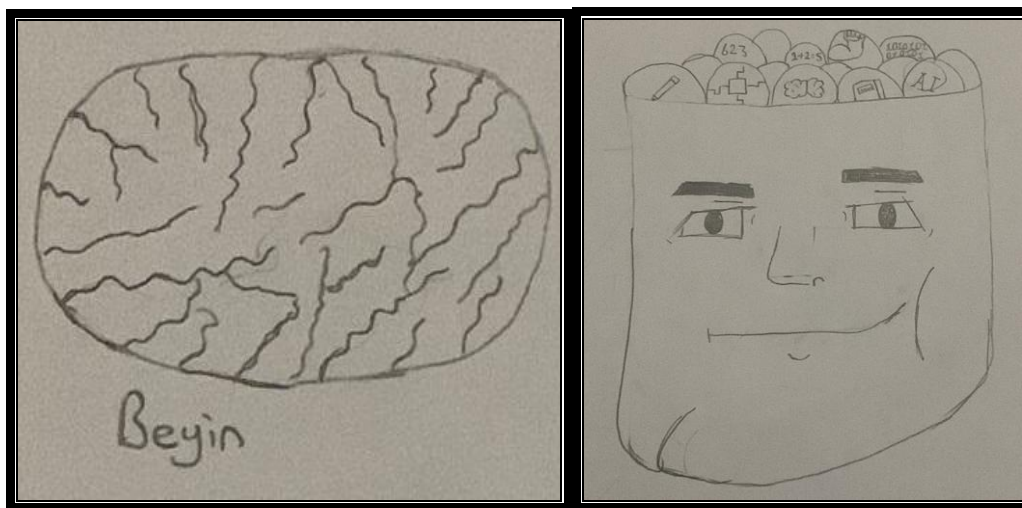

Figure 4. Examples of students' brain/mind category

This finding reflects a more abstract understanding of AI, moving beyond its physical representations (e.g., robots or devices) and instead focusing on its intellectual and decision-making capacities. Media representations, science-related discussions in classrooms, and visual metaphors used in textbooks or online content may contribute to this conceptual link between AI and the brain.

Interviews supported this interpretation. Students in this group often explained their drawings by referring to intelligence, thinking, or learning. Student 4, who drew a human brain connected to a chip, stated: *"Artificial intelligence is like a brain, but it's not human. It can learn and decide like we do."* This perspective, echoed by other students in the same category, shows that some students internalize AI not just as a machine or tool, but as an artificial cognitive system. The views of Student 4 who drew brain were given below.

Researcher: What do you think artificial intelligence is?
Student 4: I think it's like a brain that has stored information in advance and offers it to people.
Researcher: What do you understand when you say artificial intelligence?
Student 4: When I say artificial intelligence, I think it is a brain because we learn new things thanks to it.
Researcher: Where is artificial intelligence used in daily life? Can you give an example?
Student 4: It is used in homework. For example, we consult on the construction of a machine we don't know, or it can summarize a book. I think it can do everything we would do by thinking.
Researcher: Where can artificial intelligence be used in education?
Student 4: For example, when there is no teacher, we can ask AI to say something about a subject and have it said it like a teacher. If there is something we don't know, we can ask the AI.
Researcher: Can you explain what you want to say in this drawing?

Student 4: There is a human being here, but its brain has all the information. Think of it like a brain made by humans, it has a lot of information like coding, something like a brain that has answers to everything. It can help us learn and decide like we do.

Human/World–AI Interaction

The *Human/World–AI Interaction* category was selected by 8% of the students. Figure 5 presents two representative examples from this group. Drawings in this category often depict scenarios in which humans and artificial intelligence systems interact such as a person talking to a robot, AI controlling aspects of daily life, or AI influencing global systems—highlighting students' awareness of the relationship between humans and intelligent technologies. This finding suggests that a subset of students perceives artificial intelligence not merely as a device or a system but as an entity that actively interacts with people and their environment. Such representations may reflect students' exposure to popular media narratives, science fiction content, or discussions around the social and ethical dimensions of AI.
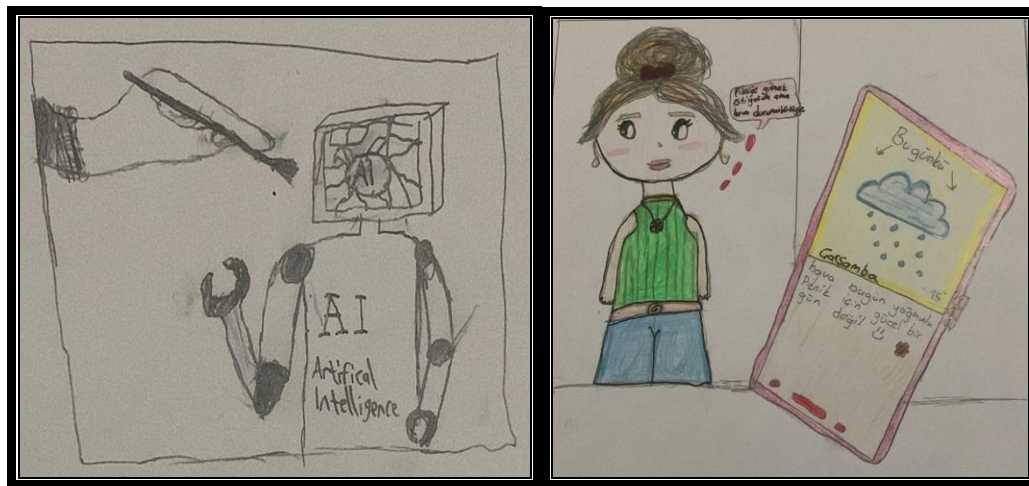

Figure 5. Examples of students' human/world–AI interaction category

Interview data further supported this interpretation. Students who drew this type of image often described AI as "something that helps people" or "a system that changes the world." Student 5, for instance, explained their drawing as follows: *"Artificial intelligence works with humans. It helps in hospitals, schools, and even in space."* This type of response suggests that these students view AI as a collaborative and global force that extends beyond a single device or function. The opinions of Student 5 are below given.

Researcher: What is artificial intelligence according to you?
Student 5: It is something that can access all kinds of information written by humans, do the math equation of things, draw pictures, make articles, make videos, and provide all kinds of human services.
Researcher: Can you give examples from daily life?
Student 5: For example, it can be used to prepare for an exam, to make a website or to write an article. We can talk to it whenever we want, we can communicate with it and get it to do what we want. For example, we can even ask how the weather is and dress accordingly. In short, it works for humans in every field such as hospitals, schools, and even in space.
Researcher: Where can we use artificial intelligence in education?
Student 5: We can have it prepare daily study routines; we can have it note down questions that will appear in lessons and exams.
Researcher: What did you want to explain in this drawing, can you explain?
Student 5: I drew something like this because not all kinds of information are known by humans, but it was still made by humanity and thanks to it we can access all kinds of information. In Michelangelo's painting of the creation of Adam, there is God, he blows Adam with his tongue and Adam suddenly comes to life. Inspired by him, in my painting, for example, the human makes it by a human hand, and it comes to life in artificial intelligence, and everything is in the service of human beings with human hands.

Examples of Artificial Intelligence

The *Examples of Artificial Intelligence* category was represented in 10% of the students' drawings. Figure 6 shows one example from this group. It shows different AI applications such as Gemini, Azar Siri, or Chatgpt. This suggests that these students encounter concrete and recognizable uses of AI in their daily lives, especially in their homes, schools or through digital platforms such as YouTube, games and learning apps. In contrast to abstract or symbolic depictions, the drawings in this category reflect a more functional understanding of AI based on real-world experiences.

Interview data also revealed that students were active users of artificial intelligence applications such as Azar, Gemini, and ChatGPT, which influenced the way they represented AI in their drawings. Student 6 associated artificial intelligence with various well-known applications and platforms, stating: *"When I think of artificial intelligence, I think of tools like Google, ChatGPT, Azar, Gemini, and Siri because I use or see them in my daily life. For me, these represent what artificial intelligence is."* Rather than perceiving AI as an abstract system or an embedded technology, some students view it through the lens of familiar, branded applications that they use in their daily routines. This experiential approach to AI may also explain the preference for the Examples of Artificial Intelligence category, where students represent AI based on recognizable, real-world tools rather than technical or theoretical constructions. Student 6's views on this issue are as follows.

Researcher: What is artificial intelligence in your opinion?
Student 6: Artificial intelligence is an application that answers when we ask a question, an application that behaves like a real human being, I think like Siri, Azar, Gemini, ChatGPT.
Researcher: So, what do you understand when you say artificial intelligence?
Student 6: These applications come directly to my mind.
Researcher: Can you give examples from daily life?
Student 6: When solving questions, doing homework, cooking recipes, playing computer games, when we are curious about countries, predicting football matches, for example, we ask them all in every field. I sometimes ask the same thing to all of them, for example, the result of the match.
Researcher: Where can we use artificial intelligence in education?
Student 6: By asking questions, doing homework, when there is a subject, we don't know.
Researcher: What did you want to explain in this drawing, can you explain?
Student 6: Artificial intelligence applications, ChatGPT, Gemini, Chrome, Azar, I know these, so I wrote these.
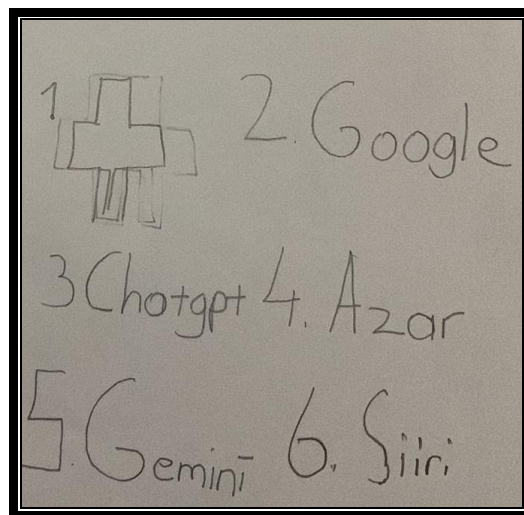

Figure 6. Example of student artificial intelligence examples category

Artificial Intelligence Code

The *Artificial Intelligence Code* category accounted for 5% of students' drawings. Figure 7 presents two representative examples from this group. These drawings typically included lines of code, binary digits (0s and 1s), algorithmic symbols, or stylized code interfaces, indicating that some students perceive artificial intelligence as something that is fundamentally built and operated through programming. This category reflects a more technical and behind-the-scenes understanding of AI. Students who drew AI in the form of code appear to conceptualize it not as a visible machine or application, but as a process that takes place within a system's internal logic. This awareness may stem from exposure to coding platforms, computer science courses, or visual materials where AI is shown as something created and controlled by code.

Interview responses supported this interpretation. Students in this group frequently described AI as "something made by people who know how to code" or as "a software that follows commands." Student 7, who drew a screen with code lines, stated: "Artificial intelligence is a system that runs with codes written by humans. Without code, it wouldn't work." This perspective highlights a developer-oriented view of AI and suggests that even a small number of students associate AI more with its computational foundation than with its applications or physical form. Student 7 expressed his opinions as below.

Researcher: What is artificial intelligence to you?
Student 7: Intelligence is a system that works with 1 and 0 codes made by humans.
Researcher: What do you understand when you say artificial intelligence?
Student 7: An intelligence that gives logical answers to the things people ask according to the codes.
Researcher: Where do you encounter artificial intelligence in daily life? Can you give an example?
Student 7: For example, in the simplest computers, such as the internet, Google, Yandex, etc.
Researcher: How can artificial intelligence be used in education?
Student 7: At school, we can explain the subject thanks to the smart board, we can ask questions, and we can get help with homework.
Researcher: So, what did you want to explain in this drawing, can you explain?
Student 7: When we want to transfer artificial intelligence to the screen, we see the numbers 1 and 0 in the algorithms of artificial intelligence, in short, artificial intelligence is an algorithm system consisting of 1 and 0, so these came to my mind.
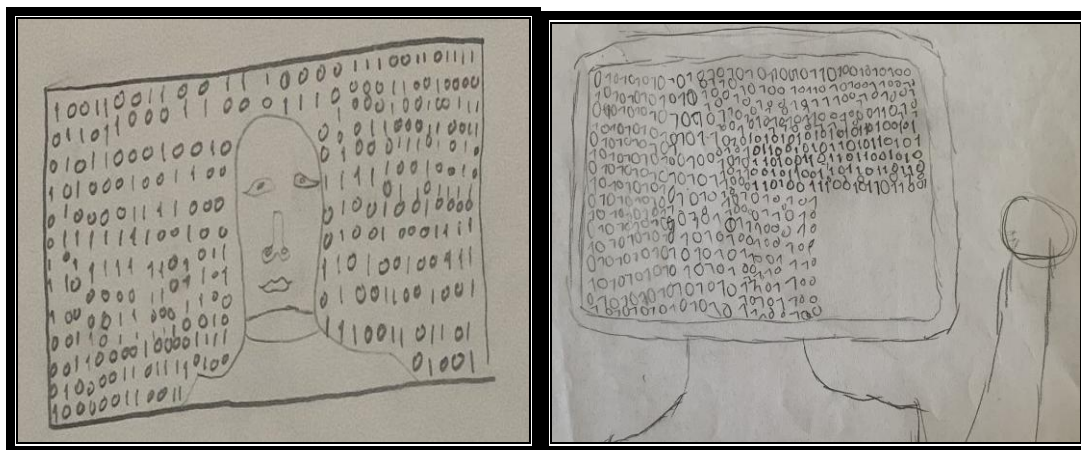

Figure 7. Example of student artificial intelligence code category

Unmanned Vehicle

The *Unmanned Vehicle* category was the least represented in students' drawings, with only 2% of the participants choosing to illustrate artificial intelligence through this lens. Figure 8 includes two examples depicting drones, self-driving cars, or aircraft without human pilots. Despite being a well-known application of AI in modern technology, unmanned vehicles were rarely depicted by students.

This limited representation may indicate that while students are aware of such technologies, they do not readily associate them with the broader concept of artificial intelligence. It may also suggest that these applications are perceived as more distant or specialized, and not as integrated into students' daily lives as other AI forms like robots, computers, or smart devices.

Interview data echoed this interpretation. Students who chose this category often referred to what they had seen in the news, documentaries, or social media. Student 8, who drew an unmanned airplane, commented: "Artificial intelligence is what allows an unmanned airplane to know its route and follow it accurately without human intervention.". Although such statements show a correct understanding of AI in autonomous systems, the low frequency of such drawings suggests that this association is not as dominant in students' mental models of artificial intelligence. The opinions of Student 8 are given below.

Researcher: What is artificial intelligence to you?
Student 8: It is a technology made by humans but not involving humans.
Researcher: So, what do you understand when you say artificial intelligence?

Student 8: Something that is unmanned but human dependent.
Researcher: Can you give examples from daily life?
Student 8: Unmanned vehicles, drones, cars and airplanes.
Researcher: Where can we use artificial intelligence in education?
Student 8: In school, we can use it when we do our homework, it is used in smart board and smart pen.
Researcher: What did you want to explain in this drawing, can you explain?
Student 8: First, I wanted to draw an unmanned airplane, which knows its own route and follows it correctly, after all, this is an artificial intelligence.
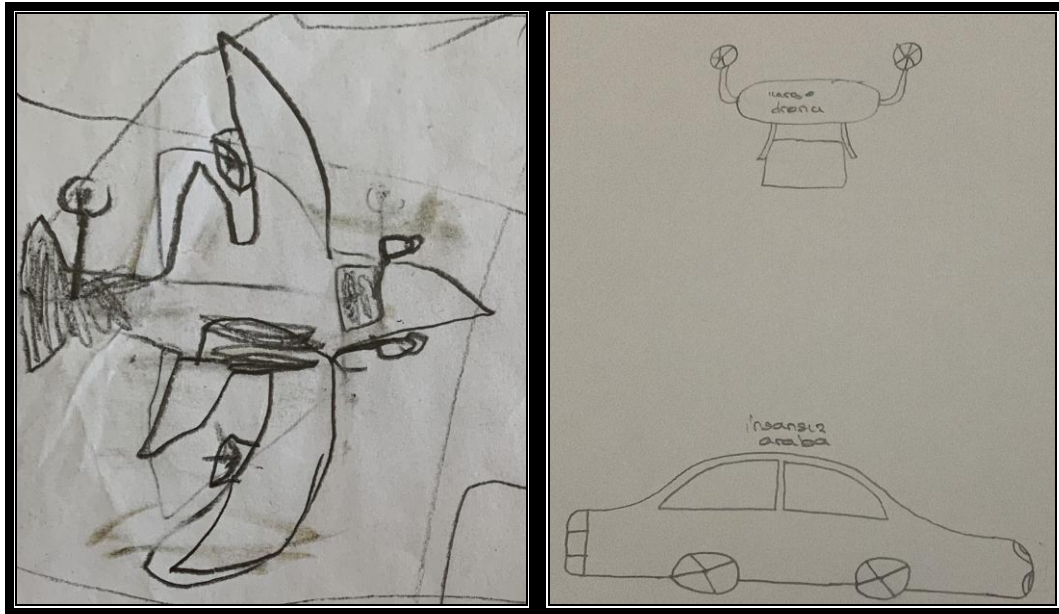

Figure 8. Examples of students' *unmanned vehicle* category

Discussion

The findings of this study indicate that middle school students primarily conceptualize artificial intelligence through visible and interactive technologies, such as robots, computers, and smart devices. This pattern aligns with previous research emphasizing that younger students often equate AI with humanoid machines or digital tools that perform helpful tasks (Cetin & Baklavacı, 2024; Sacan et al., 2022). Looking at other studies, it is seen that artificial intelligence is generally likened to machines with human-like intelligence (Fjelland, 2020; Kumar et al., 2020; Dwivedi et al., 2024). In the study conducted by Demirtas and Turksoy (2023) at the primary education level, it was determined that parents generally associated artificial intelligence with inanimate beings, and the most frequently used metaphors were robot and computer. Teachers, on the other hand, emphasized the computer in their metaphors about artificial intelligence and emphasized the goal-oriented and helpful features of artificial intelligence. Students, on the other hand, generally evaluated artificial intelligence as a technology that facilitates their lives, contains information, can think and is artificial.

The prevalence of robot imagery reflects a media-driven mental model in which artificial intelligence is personified or anthropomorphized. Such representations may stem from cartoons, films, and video games, which commonly portray AI in robotic form. In the literature, although the age groups of the participants differ, it is seen that the meanings attributed to the concept of Artificial Intelligence (AI) in various studies are generally gathered in similar themes such as robot, technology, human intelligence, assistant, machine and auxiliary system (Sacan et al., 2022; Hosgor et al., 2023; Akbay & Yıldırır, 2024; Altuntas & Karabay, 2024; Arslantas & Atas, 2024; Ericok et al., 2024; Gunerhan -Sadık, 2024; Karacif, 2024; Korkmaz & Cılsalar-Sagnak, 2024; Sezer, 2024;Yılmaz, 2024; Gunes &Yılmazlar, 2025; Isık & Kose, 2025). Similarly, the frequent association with computers and smartphones underscores how daily interaction with AI-embedded tools—such as voice assistants or educational apps—shapes students' understanding. In the study conducted by Coskun (2024), some of the prospective teachers explained artificial intelligence through technological tools such as computers, smartphones and applications such as ChatGPT and Gemini.

The appearance of more conceptual or abstract categories, such as brain/mind and AI code, reveals that some students have begun to internalize the idea that AI involves thinking, learning, and programming, even if they lack technical depth. Drawings of neural networks or binary digits suggest early exposure to more advanced notions of how AI operates, possibly introduced through school lessons, extracurricular coding activities, or online content. In various studies, it is seen that artificial intelligence is associated with the human brain, especially in the context of education; it is interpreted with metaphors such as brain, imitation of human mind and artificial mind (Agmaz & Ergulec, 2024; Lindner & Berges, 2020; Ozmen- Yagız, 2024).

Interestingly, the Examples of AI category provided a functional lens, with students referencing specific applications like ChatGPT, Gemini, or Siri. These brand-driven associations demonstrate that many students experience AI not as a system, but as a named service that assists with daily tasks. This finding resonates with contemporary literature indicating that children often identify AI through product interaction rather than conceptual understanding (Zhang & Aslan, 2021). Moreover, the widespread use of ChatGPT led students to directly cite it as an example of Artificial Intelligence (Isık & Kose, 2025). On the other hand, low representation of unmanned vehicles indicates that while students may be aware of advanced AI applications like autonomous drones or cars, they do not readily incorporate these into their personal conceptions of AI. This could be due to their perceived distance from such technologies, which are not commonly encountered in their everyday lives.

Conclusion

This study investigated middle school students' perceptions of artificial intelligence (AI) through visual and verbal representations. The analysis of students' drawings and accompanying interviews revealed that their understanding of AI is largely shaped by their everyday interactions with technology, particularly robots, computers, and smart devices. These findings suggest that students tend to associate AI with tangible and functional entities rather than abstract systems or underlying processes. While a majority of students demonstrated a surface-level awareness of AI—focusing on visible applications such as virtual assistants or robotic tools—a smaller group showed emerging conceptualizations involving thinking systems, coding structures, and human–AI collaboration. This diversity of representations reflects varying degrees of exposure, familiarity, and cognitive development regarding the concept of AI. In conclusion, students' mental models of artificial intelligence are influenced by media, technological access, and personal experiences, and while many representations are practical and realistic, there is significant room for growth in terms of conceptual depth and critical awareness. Promoting such understanding is essential in preparing students for a future increasingly shaped by intelligent technologies.

Recommendations

In this study, a total of eight categories were found, and these categories can be enriched in future studies on other groups. The study revealed significant challenges in obtaining in-depth conceptual insights from students, as their perceptions of artificial intelligence were predominantly shaped by concrete, media-influenced representations. This superficial understanding was attributed to their limited exposure to abstract AI concepts and ethical dimensions. Considering these findings, future research should focus on promoting students' conceptual and critical engagement with AI through longitudinal and intervention-based approaches that incorporate ethical discussions, computational thinking, and abstract reasoning. Additionally, examining the roles of teachers, socioeconomic factors, and cultural contexts may provide a more nuanced understanding of the variables influencing students' mental models of artificial intelligence.

Scientific Ethics Declaration

* The authors declare that the scientific ethical and legal responsibility of this article published in EPESS Journal belongs to the authors.

Conflict of Interest

* The authors declare that they have no conflicts of interest

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