J Inno Sci Eng, 2025, 9(2):309-326

Research Article

DOI:https://doi.org/10.38088/jise.1665195

Artificial Intelligence is like…: Nursing Students' Perceptions Through Textual and Visual Metaphors

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ARTICLE INFO

Received Date: 25/03/2025
Accepted Date: 16/09/2025

Cite this paper as:
Çiçek Korkmaz, A., & Altuntaş, S. (2025). Artificial Intelligence is like…: Nursing Students' Perceptions Through Textual and Visual Metaphors. *Journal of Innovative Science and Engineering.* 9(2), 309-326.

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Keywords:
Artificial intelligence
Metaphor
Nursing education
Nursing student
Perception
Qualitative research

ABSTRACT

The rapid advancement of technology has positioned artificial intelligence (AI) as a transformative force in nursing education and clinical practice. Nursing students' perceptions of AI are critical to its meaningful integration into their learning experiences and future professional roles. This study explored these perceptions through textual and visual metaphors. Conducted in 2023 with 270 nursing students, the study involved collecting AI-related metaphors and corresponding illustrations. Using metaphor analysis, the data were categorized into three overarching themes: positive, negative, and dual-impact metaphors. Positive metaphors reflected AI's human-like abilities, controllability, technological advancement, accessibility to information, facilitation of learning, and undiscovered potential. Negative metaphors emphasized concerns such as loss of control, lack of emotion, dependency, and diminished human effort. Dual-impact metaphors captured both the advantages and potential risks of AI. The metaphor "robot" emerged as the most frequently used, emphasizing students' perception of AI as a functional and efficient assistant. The findings revealed a clear progression in perceptions across grade levels. First-year students tended to express simpler and more concrete views, while senior students demonstrated more critical, multidimensional, and abstract perspectives. Such a developmental trajectory suggests that academic progression fosters deeper reflection and critical awareness regarding AI. Higher-grade students were more likely to highlight ethical, emotional, and professional implications of AI use in nursing. This study highlights that nursing students develop a balanced awareness of AI, acknowledging both its benefits and challenges. These insights underline the importance of tailoring AI-related content in nursing education to different academic levels. Understanding these perceptions can guide the integration of AI into nursing education, ensuring that students are prepared to engage with AI in a thoughtful and informed manner.

1. Introduction

Artificial intelligence (AI) revolutionizes healthcare by offering innovations ranging from preventing misdiagnoses and medical errors to enhancing efficiency [1, 2]. In the field of nursing, AI has the potential to transform patient care by facilitating routine tasks, reducing workload, and enabling faster clinical decision-making processes [3, 4]. These features not only enhance the quality of nursing care but also make a significant contribution to professional development.

The impacts of AI extend beyond healthcare services, offering significant opportunities for nursing education as well. AI offers students new learning

opportunities by supporting individualized and adaptive learning processes [5]. For nursing education programs, equipping students with the skills to utilize AI effectively is essential for adapting to the rapidly evolving healthcare sector. However, the success of this transformation depends on understanding nursing students' perceptions and attitudes toward AI [6].

In recent years, AI technologies have been increasingly utilized to create advanced simulation environments, virtual patients, decision-making support systems, and interactive learning tools in nursing education [7, 8]. These applications not only improve students' clinical reasoning and self-efficacy but also provide immediate feedback, enhance engagement, and offer personalized learning pathways [9, 10]. Moreover, AI supports the development of digital literacy and helps foster practical communication skills, making it a valuable component of contemporary nursing curricula [11].

Nevertheless, these technological advancements present challenges that need to be addressed responsibly. Studies report that over-reliance on AI, unfamiliarity with emerging technologies, and anxiety related to its use may hinder learning outcomes [8]. Therefore, the integration of AI should be balanced with human interaction, critical thinking, and professional empathy to prepare competent and compassionate nurses [7, 12].

Studies examining nursing students' perceptions of artificial intelligence (AI) are available [13-15] however, they often rely on structured data collection tools, such as scales and surveys. These tools typically do not enable students to express their thoughts and emotions about AI in-depth and comprehensively [14,15]. Therefore, there is a need for research methods that allow students to articulate their perceptions of AI freely and without limitations. Metaphors feature as a powerful tool in this context. They provide a means for individuals to convey their perceptions and emotions about a concept through their ideas [16]. By making abstract and complex concepts more concrete and familiar, metaphors help to explain how individuals perceive the world and make sense of their learning processes [17]. Furthermore, metaphors can offer valuable insights into future curriculum practices and improvement processes based on students' experiences [18].

In this regard, examining students' metaphorical perceptions of AI can provide not only cognitive and emotional insights but also pedagogical guidance for shaping nursing education. Understanding how students perceive AI—whether as a tool, a threat, or an opportunity—may inform the development of instructional strategies, simulation designs, and curricular content that respond more effectively to students' needs and concerns [8, 12].

Thus, this study not only contributes to the literature on students' conceptualization of AI but also offers reflections that can help tailor educational interventions in nursing education, particularly in a technological era shaped by AI-driven innovation. Although metaphor-based studies exploring perceptions of artificial intelligence have been conducted with various groups such as children [19], teacher candidates [20, 21], university students [22, 23], healthcare professionals [24], and gifted students [25], no study focusing specifically on nursing students using metaphor analysis was identified in the literature. This study addresses this gap by exploring how nursing students across different class levels conceptualize and critically evaluate AI in relation to their profession. Unlike prior studies that either broadly address university populations or focus on education professionals, this research directly links metaphorical thinking to nursing-specific educational contexts, thereby offering a novel and discipline-oriented perspective to guide pedagogical strategies in nursing education.

2. Aim of the Study

This study aims to examine nursing students' perceptions of the AI concept through textual and visual metaphors. In this context, the study seeks to answer the following questions: (1) What metaphors do nursing students develop for AI? (2) Under which thematic categories are these metaphors classified based on their metaphorical content? (3) How do nursing students perceive the concept of AI across different class levels?

3. Method

3.1. Study design

This is a qualitative study employing textual metaphor analysis technique based on a phenomenological approach. To gain a deeper understanding of nursing students' perceptions of the AI concept, the study's participants were asked to create a metaphor describing AI and then draw an image illustrating this metaphor. Metaphors are considered an effective way to explain individuals' understanding and perception of abstract concepts [26]. Visual metaphors further enhance this by

serving as a valuable data source, enabling abstract ideas to be made more concrete [27].

3.2. Setting and participants

The study was conducted in the fall semester of the 2022-2023 academic year with 426 nursing students enrolled at a university in Turkey. In applying maximum variation sampling, key variables such as class level (from first to fourth year) and gender were taken into account. Using the maximum variation sampling method, 202 students were targeted, considering a 5% margin of error and a 95% confidence interval. During the research process, although 292 students were reached, metaphors or images that were irrelevant or unclear were excluded from the analysis, and the study was finalized with 270 students.

3.3. Data collection

The study's data were collected between October and December 2023 using a questionnaire prepared by the researchers. Data collection was jointly carried out by both authors, both of whom are female faculty members, to ensure accuracy and reliability. The first section of the questionnaire included demographic questions such as age, sex, academic level, familiarity with AI, knowledge about the use of AI in healthcare, and attitudes toward the use of AI in nursing practices. In the second section, the sentence "Artificial intelligence is like... because..." was used to find out students' metaphors about AI. The "artificial intelligence is like..." aimed to identify students' perceptions of AI, while the "because..." part provided an opportunity to explain the thoughts and emotions underlying these perceptions. The structure of the questionnaire was developed based on previous metaphor-based studies conducted in educational and health-related contexts, particularly those focusing on artificial intelligence [19, 28, 29]. Drawing on these sources, the researchers adapted the instrument to explore nursing students' perceptions of AI through the use of metaphors. To ensure the content validity and clarity of the metaphor prompt, expert feedback was obtained from two faculty members who specialize in qualitative research and nursing education. While no standardized scale was employed, the sentence completion approach ("AI is like... because...") is a well-established method in metaphor research and has been widely used to investigate individuals' cognitive and emotional representations of abstract concepts such as artificial intelligence.

In the third section, students were asked to visually represent their metaphors by drawing a picture or cartoon with the prompt "Draw a picture/cartoon related to the metaphor you typed." According to Bozdoğan and Güven (2020), the combined use of written and visual materials enhances data diversity, improving the validity of the study. However, the visual data in this study were not subjected to independent psychosocial or thematic analysis. Instead, the drawings were used solely as supportive materials to complement the textual metaphors, which served as the primary basis for interpreting students' perceptions of artificial intelligence. Completion of the questionnaire took approximately 20–25 minutes.

3.4. Ethical considerations

Ethical approval for the study was obtained from the non-interventional research ethics committee of a university's Faculty of Health Sciences (Decision no: 2022-151, date: October 18, 2022), as well as written permission from the institution where the research was conducted. All participants participated in the study voluntarily and were provided with detailed information about the study in the introductory section of the data collection form. The participants were informed about the concept of metaphors, and an explanatory example related to another topic was provided to facilitate understanding. This study was supported by the Scientific Research Projects Coordination Unit of the University of Bandırma Onyedi Eylül under the project number BAP-23-1004-005.

3.5. Data analysis

The analysis and interpretation of students' metaphors regarding AI were carried out using a qualitative research approach known as "Metaphor Analysis," which is recognized in international literature [30], associated with content analysis by [31] and conceptualized in five analytical steps by [32] within the Turkish academic context.

1. Coding and refinement: Metaphors were alphabetically listed, and names and descriptions were reviewed to resolve inconsistencies. The participants were assigned numerical identifiers.

2. Metaphor grouping: A total of 22 participants' data—comprising either textual metaphors, visual drawings, or both—were excluded due to irrelevance, ambiguity, or lack of conceptual clarity. Metaphors and drawings were considered unsuitable if they did not reflect any meaningful association with artificial intelligence, were incomprehensible, or lacked symbolic coherence. Both researchers independently reviewed the exclusion process, and any

discrepancies were resolved through discussion to ensure consistency and reliability. Although visual data were included in the evaluation process, they were not subjected to a separate analytical method and were interpreted alongside textual metaphors. This integrated approach allowed the researchers to contextualize visual content based on the accompanying written metaphor statements.

3. Category/theme development: Three main themes and 11 sub-themes were created based on shared characteristics and justifications. The same metaphors were included in multiple categories, each with a different interpretation.

4. Ensuring validity and reliability: The coding and theme development were independently conducted by both authors. Following the initial coding, the researchers compared their categorizations, and discrepancies were discussed until consensus was reached. The inter-coder reliability was calculated as 92% by the [33] formula, ensuring the trustworthiness of the analysis process.

5. Transferring of data to digital format: Metaphors were transferred to a computer using Microsoft Excel, where the data were systematically organized. Frequencies and distributions of the themes were calculated and tabulated digitally, and the results were presented in the findings section.

4. Results

Of the participants, 81.9% were female, with a mean age of 21.66 ± 2.05 years. The class distribution revealed that 27% were first-year students, 24.8% were second-year students, 27.8% were third-year students, and 20.4% were fourth-year students. Regarding knowledge of AI, 51.5% stated they were somewhat knowledgeable, while 46.7% indicated partial knowledge of its use in healthcare. In addition, 88.1% expressed support for the use of AI in nursing practices (Table 1).

Table 1: Descriptive characteristics of the students

Variables		**Min-Max**	**M±Sd**
Age		19-38	21.66± 2.05
		n	**%**
Sex	Female	221	81.9
	Male	49	18.1
Grade	First grade	73	27
	Second grade	67	24.8
	Third grade	75	27.8
	Fourth grade	55	20.4
Choosing the department voluntarily	Yes	213	78.9
	No	57	21.1
Familiarity with AI	Yes	109	40.4
	No	22	8.1
	Partly	139	51.5
Knowledge about the use of AI in healthcare	Yes	74	27.4
	No	70	25.9
	Partly	126	46.7
Desire to use AI in nursing practices	Yes	238	88.1
	No	32	11.9

The participants generated 183 unique metaphors to describe AI (Table 2). The most frequently used metaphors were “robot” and “brain,” each accounting for 7% (n = 19). The metaphor “human” ranked third at 3% (n=8), followed by “universe” and “space,” each at 2.2% (n=6). Less commonly used metaphors included “fire,” “mirror,” and “machine,” each at 1.5% (n = 4); “computer,” “means,” “maze,” and “puppet,” each at 1.1% (n = 3).

Table 2: The most frequently used metaphors

Metaphor	n	%	Metaphor	n	%
Robot	19	7.0	Tree	2	0.7
Brain	19	7.0	Car	2	0.7
Human	8	3.0	Elevator	2	0.7
Universe	6	2.2	Knife	2	0.7
Space/vacuum of space	6	2.2	Raising a child	2	0.7
Fire	4	1.5	Galaxy	2	0.7
Mirror	4	1.5	Ship	2	0.7
Machine	4	1.5	Power	2	0.7
Computer	3	1.1	Electrical/technological home appliances	2	0.7
Means	3	1.1	Nurse	2	0.7
Labyrinth	3	1.1	Servant	2	0.7
Puppet	3	1.1	Oxygen	2	0.7
Ocean	2	0.7	Phone	2	0.7
Technology	2	0.7	Intelligence	2	0.7

Table 3 presents the main sub-themes of nursing students' metaphors regarding AI and their distribution by class levels. The metaphors were categorized under three main themes, including negative, positive, and two-way impacts. Positive metaphors included the sub-themes of human-like abilities and imitation, being human-made and controllable, technological advancement and innovation, a tool simplifying daily life, accessibility to knowledge and learning facilitation, undiscovered potential, and basic needs. Negative metaphors included the sub-themes of potential dangers and loss of control, emotionless and robotized humans, dependency, and laziness. Two-way impacts are addressed through metaphors, which assess both the positive and negative aspects of AI.

Table 3: The distribution of sub-themes of main metaphors across class levels

Sub-themes	First grade (n=73)	Second grade (n=67)	Third grade (n=75)	Fourth grade (n=55)	Number of metaphors
POSITIVE METAPHORS					
Sub-theme 1 Human-like abilities and imitation	**6 times=**Human brain/brain **2times=**Human model/human **Once=**Computerized brain My closest friend The operating system is unified in the mind Our heart A superhero Intelligence Our mind	**2 times=**Human /people, Second brain/brain **Once=,** A smart person Performing specific tasks A machine with a brain Digital brain Loaded with the human brain	**3 times=**Brain /human brain **2 times=** Robot Raising a child **Once=** Robot Brain machine An electric brain with never-ending energy	**3 times=**Brain /an added brain **2 times=**Mirro r **Once=**A human shadow Human Angel Assistant	**31**

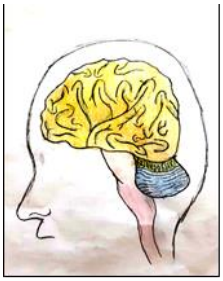
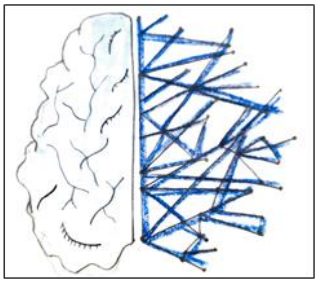
		A computer mimicking people Machines Metal brain Robot Trainee Intelligence	Power Nurse A little child		
Sub-theme 2 **Human-made and controlled**	**Once=**A hero controlled by another Information transfer A game console	**Once=**Nurse's control Robot Puppet	**Once=** Power Mathematics An automatic robot Remote control		**10**
Sub-theme 3 **Technological advancement and innovation**	**3 times**=Robot **Once**=Computer The end of an era A machine Complete Transformative machine Art bit A machine of infinite power Phone Software	**Once=**A constantly profitable business Developing world Skyscraper Machine An advanced version of the machine Robot Settings tab of the phone	**Once**=Computer The essence of life Processor Robot Technology A tree is trying to sprout	**4 times=**The universe of robots/robot **Once**=Computer Science fiction movie The first pencil strokes on a painter's canvas The touch of a human and a robot hand Technology	**24**
Sub-theme 4 **A supportive tool making life easier**	**Once=** 112 emergency call center Ambulance An arm coming from a computer Multi-purpose pocket-knife An extra arm Servant Light Achieving the impossible Lamp Robot Pushing the limits	**Once=** Assistant Caregiver A hero A light illuminating our surroundings A phone that makes life easier Machines are reducing the complexities of our lives The solution to every problem A worker who gets the job done Lever Means Compass Magic	**4 times**=Robot **Once=** A helping hand Advisory teacher Support staff A cherished brain Electronic nurse Home assistant A machine that makes life easier A bird that can settle anywhere A being that never makes mistakes Medication Means Magic lamp Translator Flying car	**Once**=Elevator Electrical/technological home appliances **Once=** Survey Car Bee Nurse Speed A shortcut Means Money A magic wand Intern	**48**

			Auxiliary staff		
Sub-theme 5 **Accessibility to knowledge and learning facilitation**	**Once=** Encyclopedia Knowledge pool Our imagination Book Private tutor A network connecting with the whole world Airplane Raindrops Recreating a moment exactly the same way after quite a while	**Once=** A ship sailing in the ocean of knowledge A single root connection from the branches of a tree A school where the teacher captures children A sea of data	**Once=** Neurons in the brain Streets of a city Sages from ancient times Visualizing a real space as if living it in our minds Living realities in the fantasy world A ship of pleasure Graduating without going to school Telepathy method Train	**Once=** Tree A ship in the ocean of knowledge Scientist A key opens all doors Human knowing everything Library City Just like a teacher	**30**
Sub-theme 6 **Unexplored potential and limitless opportunities**	**2 times=**Space **Once=**Labyrinth Forest Infinite field	**2 times=**Universe, Space/vacuum of space **Once=** Car Ghost Blackhole Ivy	**3 times=**Universe **2 times=**Galaxy, labyrinth **Once=** Branches of a tree Rainbow Rabbit hole Space	**Once=** Universe Infinite ocean Space Track	**13**
Sub-theme 7 **A basic need**	**Once=** Air and water Oxygen Rain falling on thirsty soil		**Once=** Oxygen Water Satellite		**5**
NEGATIVE METAPHORS					
Sub-theme 1 **Potential danger and loss of control**	**Once=** Digging my own grave Monster A commanding matter to humanity, Robot Hand puppet	**Once=** Fire Crayon Timed bomb Machines disrupt the world order The carotid artery is cut with knife on Tumor Boss Brain drains Dark tunnel An unrealized disaster The development	**Once=** Fire Kingdom Chaos Danger A brain dominating the world	**2 times=**Fire **Once=**Blaze Externally controlled brain	**22**

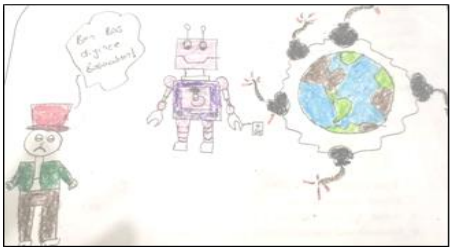
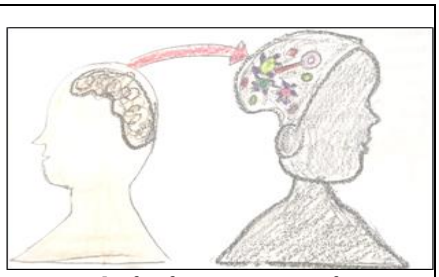
		process of humanity			
Sub-theme 2 **Emotionless and robotized human**	**Once=** Robotized humans A heartless and emotionless human A bank with a robot		**Once=** An emotionless brain An emotionless worker World of machines	**Once=** An emotionless human living in an electronic world Mechanized version of a human	**8**
Sub-theme 3 **Dependency and laziness**	**Once=** Puppeteer Alzheimer	**Once=** A world-capturing human A parasite draining a human	**Once=** Servant	**Once=** Harmful habit	**6**
BOTH NEGATIVE AND POSITIVE METAPHORS					
Sub-theme 1 **Two-way impacts**	**Once=** Ying Yang Reflection in the mirror Invasive species in the sea A phone that is good but also bad	**Once=** A bacteria Art Swirl Mirror	**Once=** Natural selection	**Once=** A convenience and a risk to humanity A strong and weak-minded animal Ocean Knife	**13**

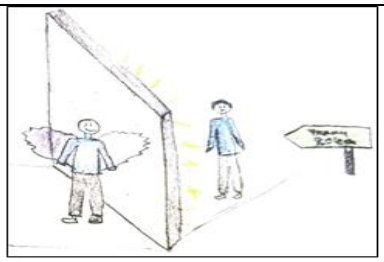
Table 4 summarizes the sub-themes of metaphors reflecting nursing students' perceptions of artificial intelligence, along with related sample expressions and the visuals drawn by the participants. Each sub-theme is explained with examples illustrating the positive, negative, and dual effects of artificial intelligence as perceived by the students. The table illustrates how the abstract concept of artificial intelligence becomes concrete in the minds of students and how these perceptions are reflected in their drawings.

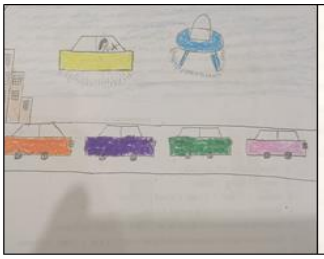
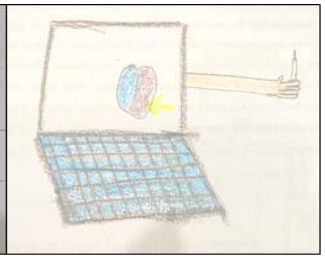
Table 4: Examples of sub-themes and drawn images

Sub-themes and sample expressions	**The images drawn by participants related to the metaphor**
Human-like abilities and imitation • AI is like the human brain. This is because the human brain can retain what it has learned and utilize the information. • AI is like our mind. It is because we can find anything we are looking for through our minds and imagination.	 The human brain's visual  The visual of our mind

<table>
<tr>
<td>Human-made and controlled

• AI is like a hero controlled by someone else. Although it performs its functions independently later, it was once created by humans. This is why humans control it.
• AI is like information transfer. This is because it is developed and made by humans.</td>
<td> 
A visual of a hero controlled by another
 
A visual of information transfer</td>
</tr>
<tr>
<td>Technological advancement and innovation

• AI is like a transformative machine because it simplifies daily tasks and makes them more basic.
• AI is like a newly sprouting tree because it was not used much in the past, but now it is needed as everyone has begun learning and understanding it.</td>
<td> 
A visual of a transformative machine
 
A visual of a newly sprouting tree</td>
</tr>
<tr>
<td>A supportive tool making life easier

• AI is like a magic wand. This is because when you need support, it is readily available under your fingertips and fulfills your wishes, making your work easier.
• AI is like a flying car. It is because it makes our work easier when we are stuck, like in traffic.
• AI is like an arm emerging from a computer. This is because a helping hand can reach anywhere.</td>
<td> 
A visual of a magic wand,
 
A visual of a car
 
A visual of an arm coming from a computer</td>
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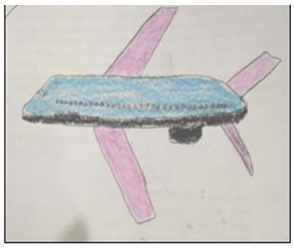
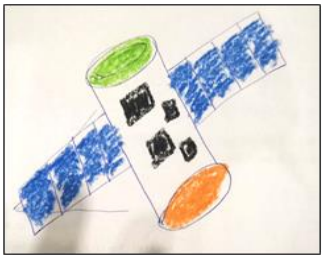
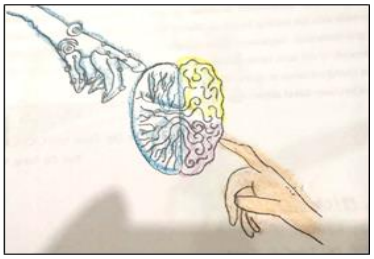
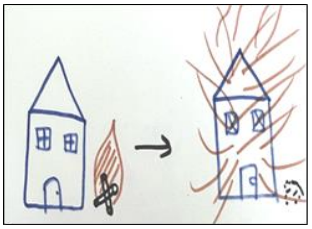
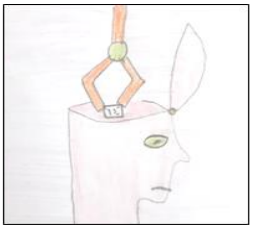
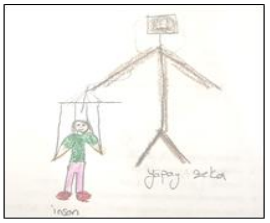
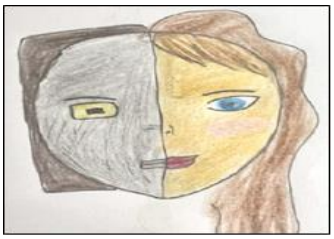
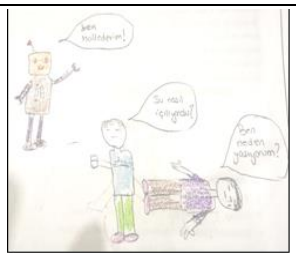
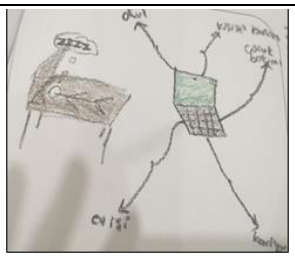
<table>
<tr>
<td>Accessibility to knowledge and learning facilitation

• AI is like a ship of pleasure. This is because, just like a ship sailing into unknown waters, it can discover new information.
• AI is a single root connection from the branches of a tree. This is because it consolidates all the data and information from a specific system in one place.
• AI is like an airplane. This is because it can travel anywhere in the world and collect information that we cannot access. It is incredibly fast. Whatever we have been trying to access for months or years can now be accomplished in seconds.</td>
<td> 
A visual of a ship of pleasure
 
A visual of a single root connection from the branches of a tree
 
A visual of an airplane</td>
</tr>
<tr>
<td>Unexplored potential and limitless opportunities
• AI is like a black hole. This is because once we enter it, we cannot escape; we cannot know what is inside, as we cannot see it; and it has no boundaries.
• AI is like a rabbit hole. This is because, as in the matrix, it is something whose direction and development we cannot predict, and we cannot fully know its results.</td>
<td> 
A visual of a blackhole
 
A visual of a rabbit hole</td>
</tr>
<tr>
<td>A basic need
• AI is like a satellite. This is because wherever we go, there will be no perception without it.
• AI is like oxygen because it is an essential force that simplifies life, meeting our needs in many areas of life without requiring much, and it is something with us in every aspect.</td>
<td> 
A visual of a Satellite
 
A visual of oxygen</td>
</tr>
<tr>
<td>Potential danger and loss of control
• AI is like blaze. This is because it grows quickly and invades the entire area.
• AI is like an externally controlled brain. This is because robots now perform many tasks that humans used to do, and AI systems are increasingly managing human activities.
• AI is like a hand puppet. This is because it can manipulate us, influencing us in a negative way.</td>
<td> 
A visual of fire
 
A visual of externally controlled brain
 
A visual of hand puppet</td>
</tr>
</table>

Emotionless and robotized human • AI is like an emotionless human living in an electronic world. This is because it can answer questions and possess knowledge on various subjects, yet it cannot approach situations emotionally like a human. • AI is like a heartless and emotionless human. This is because it can do what humans can, and even what their strength and intelligence cannot achieve, yet it operates without the ability to think or feel.	 A visual of an emotionless humans living in an electronic world  A visual of a heartless and emotionless human
Dependency and laziness • AI is like Alzheimer's. This is because people will depend on AI to do everything for them, and over time, they will forget their human abilities and responsibilities. • AI is like a parasite draining humans. Because it takes over all tasks humans are supposed to do, it makes them lazy.	 A visual of Alzheimer  A visual of a parasite draining a human
Two-way impacts • AI is like the ocean. This is because life exists there too, and uncontrolled diving into it can lead to getting lost in its infinite depths. • AI is like Yin-Yang. This is because if it evolves into a structure that broadens our horizons, it becomes beneficial. However, if it exceeds our boundaries and surpasses our influence, it becomes harmful.	 A visual of the ocean  A visual of Yin-Yang

Note: The original Turkish versions of student quotations and metaphorical expressions presented in Table 4 have been included as a supplementary file titled "Supplementary Document – Turkish Original Quotations."

5. Discussion

The study revealed that the metaphors most frequently used by students were "robot," "brain," and "human," indicating that AI is perceived not only as a tool but also as a system possessing human-like features. This finding aligns with other studies conducted with different sample groups that examined perceptions of AI through metaphors [19, 29].

The metaphor of "robot" revealed that students perceive AI as a functional assistant capable of performing tasks quickly and efficiently. This perception aligns with the notion of AI as a "life-facilitating tool" and parallels the literature emphasizing AI's functionality [34, 35]. On the other hand, the "brain" and "human" metaphors suggest that students perceive AI as a system capable of mimicking human abilities and intelligence. These metaphors, categorized under human-like abilities and imitation, associate AI with a capacity similar to human intelligence [36,37]. For example, one student stated, "AI is like the human brain. This is because the human brain can remember what it has learned and uses information," while another added, "AI is like our mind. It is because we can find anything we are looking for through our mind and imagination". As the class level was higher, students recognized more complex and human-specific dimensions of AI.

This finding is consistent with previous studies, which indicate that perceptions of technology become more profound and multidimensional at higher class levels [38]. Similar to our findings, [39] found that nursing students perceived AI as both a supportive tool and a complex technology capable of enhancing learning and clinical practice. Their study showed that while a majority of students valued AI for its role in improving efficiency and learning quality, a significant proportion also acknowledged AI's limitations in addressing emotional aspects of care. This duality parallels the metaphors of "robot" and "brain" found in our participants' narratives. This progression underscores the importance of incorporating discussions in nursing education that critically examine how AI systems replicate or substitute for human cognition and decision-making. Such content can enhance students' capacity to evaluate AI's appropriateness and limitations in clinical judgment and patient care [12].

Under the theme of "human-made and controlled," metaphors such as "puppet," "game console," and "remote control" indicated that students perceive AI not as an independent intelligence but as a system under human control. This finding aligns with the literature and demonstrates students' high awareness of the importance of human control over AI [37]. One student metaphorically explained this perspective by stating, "AI is like a hero controlled by someone else. Although it performs its functions independently later, it was once created by humans. This is why humans control it". [40] similarly emphasized the role of trust and perceived control in shaping nursing students' views on AI, reporting that trust in generative AI significantly affected its perceived usefulness. Students who felt AI remained under human oversight were more likely to view it as beneficial in educational contexts. This reinforces our finding that students prioritize human agency in AI deployment. Accordingly, AI education should enrich its content with topics emphasizing control mechanisms and the role of human will. Such an approach could broaden students' understanding of human control over AI. To cultivate humanistic competencies, AI-related modules should include reflection practices, group discussions, and ethical case analyses. This dual focus can help mitigate fears about dehumanization while reinforcing professional values.

Metaphors such as "encyclopedia," "knowledge pool," and "a network that can communicate with the entire world," used under the theme of "access to information and ease of learning," showed that students perceive AI as a source of learning and information. This perception aligns with the literature supporting AI's role in facilitating access to information in education [34]. From an educational perspective, these metaphors suggest that students already conceptualize AI as a learning companion [8]. This finding is also supported by [39], who found that AI-supported tools improved nursing students' ability to engage in self-paced learning, particularly when embedded within interactive e-learning modules. Similarly, [40] reported that AI technologies enhance students' agency and reflective engagement in digital learning environments. This evolution parallels the growing integration of AI in educational contexts, where interactive tools, virtual patients, and decision-support systems enhance students' critical thinking and clinical reasoning skills [7]. Integrating AI-based simulations, personalized learning platforms, and chatbot-supported training into nursing curricula can enhance self-directed learning and information literacy [8]. In this consideration, practical education programs can be developed to enable students to experience AI-assisted learning tools. This approach could help them better understand opportunities for accessing information and experience the effectiveness of AI in educational processes.

Under the theme of "technological development and innovation," the findings revealed that students perceive AI as a symbol of modern technology and innovation. First-year students define AI with concrete concepts like "machine" and "computer," while upper-year students use more creative and abstract metaphors such as "science fiction movie" or "the touch of a human and robot hand." This shift suggests that as students' educational level increases, they develop a broader perspective on AI and begin to evaluate technology in a more comprehensive manner [38]. This observation resonates with findings by [41], who reported that final-year medical students tended to associate AI with abstract concepts such as augmentation, collaboration, and ethical reflection, while lower-year students described it in operational or mechanical terms.

Regarding unexplored potential and limitless opportunities, students perceive AI as a technology filled with uncertainties and capable of offering yet-to-be-discovered opportunities in the future. Metaphors such as "space," "universe," "infinite ocean," and "labyrinth" illustrate that students view AI as a system with both potential and uncertainty. The increasing complexity of AI systems reveals that their operation has become incomprehensible to humans, highlighting growing concerns about their non-transparent nature [42]. This perception supports the idea that students see AI as a vast field of

exploration, while also emphasizing the need to address this view with a critical perspective. Nurse educators must address these perceptions by offering structured yet exploratory learning opportunities, enabling students to engage with AI both critically and constructively [11]. In a similar vein, [43] emphasized the importance of fostering epistemic curiosity in medical students who perceived AI as vast and enigmatic; they argue that embracing this curiosity can be transformative in clinical education.

Students exhibit a significant evolution in their perceptions of AI as their class level increases. First-year students describe AI with concrete and expanding imagery, such as "forest" or "infinite field," while fourth-year students used more abstract and multi-layered metaphors, such as "galaxy," "rabbit hole," and "rainbow." This change highlights that as the class level increases, students assess the boundaries and unexplored potential of AI from a broader perspective [44]. This finding, which indicates how students' perceptions of AI evolve throughout their learning process, highlights the importance of AI-oriented programs in education. The perception of AI as "unexplored potential" fosters positive expectations of this technology among students. Incorporating this potential into educational processes not only provides students with new learning opportunities but also contributes to the development of critical awareness [7, 45]. Introductory levels should focus on AI's basic functions and concepts, while senior courses should address ethical, technical, and policy dimensions [8, 12]. [46] further argue that progressively layered AI instruction aligned with academic maturity increases both engagement and ethical sensitivity in health sciences education.

Moreover, while class level was the primary variable analyzed in this study, other variables such as gender, digital literacy, and prior experience with AI were collected only for descriptive purposes. The decision to focus the analysis on the class level was made to examine how educational progression influences metaphorical perception and critical reflection on AI. This approach aligns with the study's objective of exploring the developmental trajectory of conceptual understanding as students advance through their nursing education. These insights should inform the design of tiered, contextually relevant AI education strategies that respond to students' evolving conceptual models while preparing them for a future healthcare environment increasingly shaped by intelligent systems. Future studies may extend this work by comparatively analyzing other demographic or experiential factors.

Metaphors associated with fundamental needs, such as "oxygen," "water," and "air," indicate that students perceive AI as an essential necessity. These metaphors reflect how AI has become a fundamental part of the technological infrastructure in today's world and is increasingly central to human life. This perception suggests that technology penetrates every aspect of life, making it difficult for individuals to live without AI in their daily lives [45]. The integration of AI technologies into various fields, ranging from education to healthcare, and from business to public services, enables students to consider this technology a fundamental necessity [44, 47]. [48] similarly found that nursing students regarded AI as indispensable to future healthcare delivery, emphasizing its growing inevitability as a digital infrastructure.

In the present study, certain metaphors highlighting students' perceptions of the negative aspects of AI have particularly attracted attention. Metaphors related to potential dangers and loss of control reflected fears that AI could escape human control. Expressions like "digging one's own grave," "monster," "robot," "fire," and "time bomb" were concrete examples of these concerns. This finding aligns with studies conducted by [42] on the risks posed by the autonomy of AI systems. Similarly, [43] reported that students expressed discomfort regarding the self-evolving and opaque nature of AI, fearing a possible loss of human authority over technology. Metaphors like "black box" and "uncontrollable chain reaction" highlighted a perceived threat in the lack of clear control mechanisms in AI systems, resonating with the metaphors found in the current study. In addition, the literature highlights the lack of transparency and the complexity of AI processes, which reinforces the perception of an uncontrollable system [48]. This situation once again highlights the need for AI systems to be more reliable and transparent in their explanations.

Students' critiques regarding the effects of AI on empathy and human values are grouped under the theme of "emotionless and robotized human." For example, expressions such as "robotic human" and "emotionless worker" reflect concerns that technology could weaken human qualities. These results align with the studies of [47] and [50]. Similarly, [41] emphasized that students in health-related disciplines feared a potential erosion of empathy and interpersonal care in AI-mediated interactions, particularly in clinical environments where emotional intelligence is crucial. These studies noted that AI could lead to a loss of empathy and weakening of social bonds in human-robot

interactions. The fact that this perception becomes more complex as students' class level increases indicates the development of their critical thinking skills. To cultivate humanistic competencies alongside technological literacy, AI-related modules should include reflection practices, group discussions, and ethical case analyses. This dual focus can help mitigate fears about dehumanization while reinforcing professional values [36]. The perceptions of dependency and laziness indicate that students acknowledge the detrimental effects of excessive reliance on AI on individual skills. In particular, concerns voiced by upper-grade students—expressed through metaphors such as "harmful habit" and "parasite"—align with warnings that excessive dependence on AI may undermine critical thinking and problem-solving abilities, as noted by researchers such as [44] and [50]. In this context, [49] noted that students feared becoming passive consumers of AI output rather than active knowledge constructors, especially when AI tools were overused without critical reflection or verification. This highlights the need for technology to be used carefully and consciously.

Ultimately, in considering the "two-way impacts," students made a balanced assessment of both the benefits and risks of AI. Metaphors such as "Yin-Yang" and "knife" have been cited as concrete expressions of this balance. The increase in the complexity of metaphors used based on class level indicates that students' perceptions of AI develop with education. This suggests that nursing education should extend beyond technical instruction and foster reflective capacities, equipping students to evaluate the implications of AI in patient care, interprofessional collaboration, and ethical decision-making [10]. In line with this, [10]highlighted the importance of dialogic reflection and cross-disciplinary debate in helping students navigate AI's dual role as both enabler and disruptor in healthcare education.

6. Limitations

Studying is limited to nursing students from a single university; thus, its generalizability to students from different universities and geographic regions is limited. The metaphor method used allows participants to express their thoughts subjectively. However, due to the nature of the method, it is open to interpretational differences, constituting another limiting factor. Additionally, the scarcity of other metaphor analysis studies on AI in nursing is a significant factor that limits the comparison of this study's findings with the existing literature. Furthermore, although demographic variables such as gender, voluntary choice of department, and prior experience with AI technologies were recorded, the analysis focused solely on the class level. This decision was based on the study's primary aim of exploring cognitive and perceptual changes across educational levels. Therefore, the exclusion of other variables from the thematic analysis is a limitation that future research may address. Another important limitation concerns the analysis of visual data. Although visual drawings were collected alongside textual metaphors, they were not analyzed with an independent visual analysis method. Instead, their interpretation was incorporated into the overall metaphorical context. This methodological decision may restrict the depth of analysis regarding visual representations and should be addressed in future studies through dedicated visual analysis techniques.

7. Conclusions and Reccomendations

This study found that nursing students' perceptions of artificial intelligence (AI) vary by class level, with more nuanced and critical views emerging as students advance in their education. While many students described AI as a tool that facilitates daily life, enhances access to information, and represents future potential, others expressed concerns about dependency, loss of autonomy, and lack of control. These findings suggest that students develop a more reflective and balanced perspective on AI as they gain educational experience.

Given this progression, it is essential to adopt a staged and developmental approach in designing AI-related content for nursing curricula. As students' class level increases, the curriculum should evolve from introducing basic AI concepts to engaging with more complex ethical, clinical, and professional issues. Profession-specific examples—such as AI-supported patient triage, clinical decision-making tools, and predictive systems for infection control—should be integrated to enhance relevance and applicability.

In addition, metaphor-based reflections, such as "AI is like a labyrinth," or "AI is like a helpful but unpredictable assistant," can be used as educational tools to uncover students' implicit perceptions and guide targeted instructional strategies. These reflections also support deeper engagement with AI's role in healthcare and promote critical dialogue.

Future research should explore how individual factors—such as gender, digital literacy, or the voluntariness of career choice in nursing—influence metaphorical thinking about AI. Longitudinal and

intervention-based studies could further illuminate how structured learning affects students' evolving understanding of AI. Finally, incorporating students' visual and verbal metaphors into classroom activities can foster critical thinking and provide educators with valuable insights into students' conceptual development.

8. Implications for Nursing Education

The findings of this study suggest that nursing education should adopt a balanced approach when addressing complex and multifaceted topics, such as AI. In addition to viewing AI as a functional tool, a resource that facilitates access to information, and an innovative technology, students also draw attention to its potential risks, such as addiction and loss of control. This necessitates addressing both the advantages and possible drawbacks of AI in education.

AI-related content in nursing education can be tailored to students' class levels and specific needs. In early class levels, the focus should be on the basic functions of AI, while in higher classes, deeper topics such as ethics, security, and control should be addressed. Furthermore, case studies, simulations, and interactive learning methods should be employed to facilitate the integration of theoretical knowledge into practice, enabling students to understand the impact of AI on nursing practices. This type of approach can enable students to evaluate AI more consciously and effectively and to utilize it in their practices.

Article Information

Financial Disclosure: This study was supported by the Scientific Research Projects Coordination Unit of Bandırma Onyedi Eylül University under the project number BAP-23-1004-005**.**

Authors' Contributions: Concept: A.Ç.K.; Design: A.Ç.K., S.A.; Supervision: A.Ç.K.; Resources: A.Ç.K.; Data Collection: A.Ç.K., S.A.; Analysis: A.Ç.K., S.A.; Literature Search: A.Ç.K.; Writing Manuscript: A.Ç.K.; Critical Review: A.Ç.K., S.A.

Conflict of Interest/Common Interest: No conflict of interest or common interest has been declared by the authors.

Ethics Committee Approval: Ethical approval for this study was obtained from the Bandırma Onyedi Eylül University of Non-Interventional Research Ethics Committee for Health Sciences (Date: 18.10.2022; No: 2022-151).

Acknowledgments: The authors would like to thank the nursing students who participated in the data collection process. The authors also express their gratitude to the Bandırma Onyedi Eylül University Scientific Research Projects Coordination Unit for their financial support.

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