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When knowledge does not translate into perception: Exploring the gap in elementary students' understanding of artificial intelligence

Joko Santoso[1*], I Made Candiasa[2], I Komang Sudarma[2], I Made Tegeh[2]

[1]*Information System Study Program, Faculty of Informatics and Computer, Institut Teknologi dan Bisnis STIKOM Bali, Bali 80239, Indonesia.*

[2]*Education Science Study Program, Postgraduate Faculty, Universitas Pendidikan Ganesha, Bali 81116, Indonesia.*

Corresponding author: Joko Santoso (*Email: joko_santoso@stikom-bali.ac.id*)

Abstract

This study aims to explore the gap between elementary school students' knowledge and their perceptions of artificial intelligence (AI) following AI based learning activities, and to examine how knowledge, awareness, and perception relate to one another in the context of early AI education. A quantitative descriptive and exploratory design was employed involving 233 elementary school students in grades five and six. Data were collected through structured questionnaires and knowledge oriented test items, then analyzed using descriptive statistics and correlation analysis. The results show that students demonstrate relatively strong understanding of basic AI concepts (M = 3.05), while awareness (M = 2.30) and perception (M = 2.30) remain at a moderate level. The correlations among the three constructs are extremely weak (r ranging from −0.040 to 0.017), indicating that knowledge, awareness, and perception develop as relatively independent dimensions rather than as a unified process. Understanding basic ideas about AI does not necessarily translate into broader awareness or more developed perceptions among elementary students. This challenges the assumption that knowledge acquisition alone is sufficient to shape how students interpret AI in wider contexts. The findings suggest that AI based learning at the elementary level should move beyond conceptual instruction and incorporate contextual, reflective, and experiential elements. Teachers should be supported in designing activities that help students connect AI concepts to real life situations, thereby bridging the gap between factual knowledge and meaningful perception of AI technologies.

Keywords: Artificial intelligence in education, AI based learning, elementary students, students' perceptions, technological awareness, exploratory study.

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1. Introduction

AI is now part of many areas of everyday life, including education, where it is used to support adaptive learning, provide automated feedback, and assist in data driven decision making [1]. Its presence in the classroom has gradually changed the way students engage with learning materials and interact with digital tools. Rather than simply accessing information, students are increasingly involved in more responsive and personalized learning environments. Recent studies have pointed to the possibility that these developments may support improvements in how learning takes place, as well as in students' academic outcomes [2]. At the same time, their influence is not limited to performance alone. They also seem to shape the way students experience learning more broadly, including how they take part in classroom activities, respond to tasks, and maintain their engagement over time.

Along with these developments, students now encounter AI in everyday digital tools, such as recommendation systems, speech recognition, and virtual assistants. For many of them, this presence becomes familiar over time. Even so, familiarity does not always mean that the underlying ideas are clearly understood [3]. Students may recognize where AI appears, yet their understanding of how it works often remains partial. What they know is sometimes drawn from bits of information rather than a more complete explanation. This can leave a degree of uncertainty, especially when AI is discussed in learning contexts. In such situations, students' responses may vary, and these responses can shape how they engage with emerging technologies in education [4, 5].

Previous research has discussed students' perceptions of AI in a range of educational settings, but the conversation has been dominated by studies in higher education [6, 7]. Within that body of work, students are often described as being familiar with AI tools, particularly chatbots, and many of them see practical value in using such tools for learning. Still, their responses are not uniformly positive. While AI is often associated with greater efficiency and possible academic benefits, students also continue to express doubts about how far it can be trusted, how ethically it should be used, and whether its growing presence might affect academic integrity or reduce opportunities for critical thinking. What emerges from these studies is not a simple positive or negative view, but a more mixed and unsettled picture. Even so, work that focuses on younger learners is still not widely represented. This is particularly the case at the elementary level, where students are only beginning to encounter technology in more structured ways, and these early experiences may quietly shape how they come to understand and respond to it over time.

This gap becomes important when viewed in the context of early learning, as experiences at this stage often influence how students later relate to technology. At the elementary level, their understanding of AI is still taking shape and tends to remain tentative [8]. Without sufficient guidance, students may develop impressions that do not fully reflect the actual capabilities or limitations of AI [9]. For this reason, it is useful to design learning experiences that introduce these concepts in ways that are easier to approach and explore, allowing students to build a more grounded understanding over time.

AI based learning is sometimes used to address this issue by bringing students closer to the ideas being introduced. Instead of relying only on explanation, students can take part in simple tasks or guided activities where they begin to notice how AI behaves in practice, for example when patterns are recognized or when systems respond to input [10, 11]. Some parts are easy to follow, others less so. Over time, these experiences can shape how students understand the topic, not only at the level of concepts but also in how they recognize its presence in everyday situations.

This does not always unfold in a straightforward way. Students may observe what happens without fully making sense of it. At this point, guidance becomes relevant. The teacher's role is not only to explain, but to help students connect what they see with what they already know, and to encourage them to reflect on what those experiences might imply.

Much of the existing research has focused on how AI can support learning outcomes, yet less attention has been given to how these learning experiences shape the way students actually perceive the technology, especially at the elementary level. What happens between exposure and perception is not always clear. Looking more closely at these processes can help explain how students move from simply knowing about AI to forming their own views of it. This becomes relevant when designing learning activities, as the goal is not only to improve knowledge, but also to support the development of more balanced and realistic perspectives on AI.

The study takes this issue as a starting point and looks at how several aspects come together, particularly AI based learning and the role of the teacher, and how these are reflected in students' knowledge, their awareness of technology, and the way they view AI. Attention is given to elementary school students, as this stage provides an early point where these forms of understanding begin to take shape. By looking at these patterns, the study aims to contribute to current discussions on AI in education, while offering a closer view of how early learning experiences may relate to how students make sense of emerging technologies.

2. Literature Review

2.1. AI in Education

AI in education can be understood as the use of digital systems that are designed to handle tasks often associated with human thinking, particularly in the context of teaching and learning. In practice, these systems are able to process student data, adjust learning materials, and provide feedback without direct intervention at every step. Their presence in educational settings has gradually changed how learning activities are organized, making it possible to tailor instruction more closely to individual needs while also supporting efficiency in the classroom. A number of studies have noted that such systems can assist with adaptive learning, encourage student participation, and help teachers keep track of learning progress in a more continuous way [12].

In addition to improving learning outcomes, AI also reshapes how students interact with knowledge [13, 14]. AI based tools allow students to engage with content in interactive and exploratory ways, which may influence not only cognitive outcomes but also attitudes toward technology [15]. Therefore, understanding the broader impact of AI in education requires examining both learning effectiveness and students' perceptions.

2.2. Students' Perceptions of AI

Students' perceptions of AI are not always easy to define, but they can be observed in how students respond to its presence in both everyday life and classroom activities. These views tend to take shape over time, influenced by what students have encountered before, what they think they understand, and the environment around them [16]. In some cases, students show interest and are more willing to engage with technology in learning. In others, they may hold back, especially when their impressions are uncertain or not fully formed.

At the same time, these perceptions do not stand apart from students' level of understanding. When knowledge is still limited, students may rely on assumptions that do not fully align with how AI actually works [17]. As their understanding grows, their views often become more balanced, although this does not always happen in a straightforward way. This suggests that learning experiences matter not only for building knowledge, but also for shaping how students interpret and respond to the presence of AI in their environment.

A growing body of literature further supports the idea that perceptions of AI are multidimensional rather than unidirectional. Research has shown that cognitive, affective, and behavioral components of perception may develop at different rates and respond to different types of learning stimuli. For instance, students may develop factual understanding of AI through direct instruction, yet their emotional responses and behavioral intentions toward AI may depend more heavily on contextual experiences and social interactions. This complexity becomes even more pronounced in younger learners, whose cognitive frameworks for evaluating technology are still in early stages of development. Consequently, studies that examine perception as a single outcome of knowledge transmission may overlook the layered nature of how students come to understand and relate to AI technologies.

2.3. AI Based Learning in Elementary Education

In elementary classrooms, AI is not always introduced through formal explanation. More often, it appears through small activities that students can follow step by step [18]. A short task, a simple project, or a guided exercise may be enough for them to start noticing how patterns are recognized or how systems respond to input. Some parts are easy to follow, others take time. The aim is not to explain everything in detail. Instead, students are gradually exposed to the ideas, usually by linking them to situations they already know.

A number of recent reviews suggest that AI learning in K 12 classrooms tends to rely on experiential approaches, where students learn through doing, observing, and discussing [19, 20]. These experiences have been linked to improvements not only in AI literacy, but also in problem solving and motivation, although the outcomes are not always uniform. In elementary contexts, the question of how content is introduced becomes particularly important. When the material is adjusted to students' level, both teachers and students seem better able to work through ideas that might otherwise feel too abstract [21, 22].

2.4. Teacher Guidance in AI Learning

In classroom practice, the role of the teacher becomes particularly visible when students work with ideas that are not immediately easy to grasp, such as AI. At this point, guidance is not only about delivering information. It also involves helping students make sense of what they encounter, especially when new concepts do not easily connect with what they already know. In some situations, students may follow the activity, yet still be unsure about what it means. This is where the teacher's presence matters, as it supports students in linking different pieces of understanding and reflecting on their experience.

Studies in technology enhanced learning have pointed to a similar tendency, where teacher support helps students engage more meaningfully with digital tools and learning content, although the effect may vary across contexts [23, 24].

2.5. Students' Knowledge and Technological Awareness

When students talk about AI, what they know often shows up in how they describe simple processes, for example how systems deal with data, identify patterns, or generate results [17]. This kind of understanding does not always appear explicitly, but it can be noticed in the way they react to or make sense of AI related situations.

A different but related aspect is technological awareness. This is reflected in how students notice the presence of technology in everyday life and how they think about its influence on decisions and social interactions. When this awareness is more developed, students may be better able to consider both the potential benefits and the possible risks associated with AI [25].

Some studies have noted that knowledge and awareness do not stand completely apart, although the connection between them is not always straightforward [26, 27]. In certain cases, students who understand more about technology also seem more aware of how it appears in their daily lives, yet this relationship does not always follow a clear pattern. Because of this, both aspects are often considered together when trying to make sense of how students come to form their views of AI.

Despite the growing interest in AI education, there remains a notable gap in the literature regarding how these cognitive and perceptual dimensions interact in the context of younger learners. Most existing studies have examined knowledge, awareness, and perception either in isolation or within higher education contexts, where students already possess more developed cognitive frameworks. In elementary settings, however, these constructs may function quite differently. The assumption that knowledge leads to awareness and subsequently to perception — a linear progression often implied in technology acceptance models — has not been sufficiently tested among younger populations. This gap in the literature motivates the current study, which seeks to examine whether such a sequential relationship holds or whether these dimensions develop independently in early AI learning experiences.

3. Research Model and Hypotheses

3.1. Research Model

This study proposes a structural model to explain how AI based learning influences elementary students' perceptions of AI. The model integrates both instructional and cognitive factors, including AI based learning effectiveness, teacher guidance, students' knowledge, technological awareness, and students' perceptions of AI.

AI based learning effectiveness refers to the extent to which learning activities successfully facilitate students' understanding of AI concepts through interactive and structured experiences. Teacher guidance represents the instructional support provided by teachers to help students interpret learning content and develop meaningful understanding. These two constructs are expected to play a central role in shaping students' knowledge of AI.

Students' knowledge of AI is considered a key cognitive factor that influences how students interpret and evaluate AI technologies. As students gain more accurate understanding of AI systems, they are more likely to develop higher levels of technological awareness. Technological awareness reflects students' understanding of the role and impact of technology in everyday life and society.

Finally, students' perceptions of AI represent their overall attitudes and evaluations toward AI technologies. These perceptions are shaped by both cognitive understanding and awareness of technology. The proposed model assumes that AI based learning does not directly influence perceptions, but operates through knowledge and technological awareness as mediating factors.

3.2. Hypotheses Development

Based on the theoretical framework presented in the previous section, this study develops a set of hypotheses to explain the relationships among instructional factors and students' cognitive and perceptual outcomes in the context of AI based learning. The proposed model assumes that learning effectiveness and teacher guidance function as key antecedents that influence students' knowledge of AI, which subsequently contributes to the development of technological awareness. In turn, technological awareness is expected to shape students' perceptions of AI. These relationships reflect a sequential process in which structured learning experiences and instructional support enhance cognitive understanding, which then influences how students interpret and evaluate emerging technologies.

The proposed research model integrates instructional and cognitive factors to explain how AI based learning influences elementary students' perceptions of AI. The model assumes that AI based learning effectiveness and teacher guidance serve as primary antecedents that enhance students' knowledge of AI. This knowledge is expected to contribute to the development of technological awareness, which subsequently shapes students' perceptions of AI. The relationships among these constructs reflect a sequential process in which structured learning experiences and instructional support influence cognitive understanding, which then affects students' evaluation of emerging technologies. The proposed research model is presented in Figure 1.

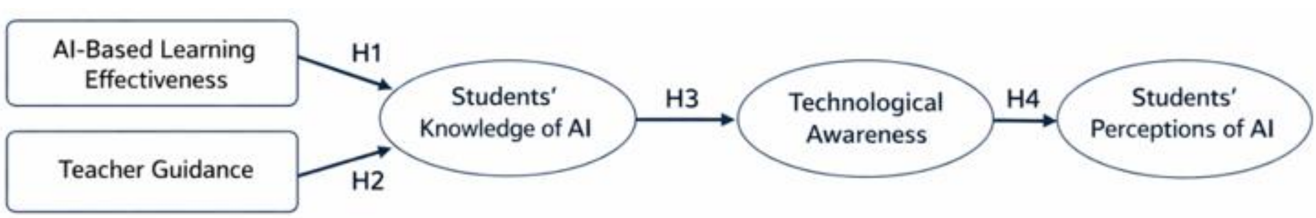

Figure 1.
Proposed Research Model of AI Based Learning and Students' Perceptions of AI.

- H1: AI based learning effectiveness positively influences students' knowledge of AI.

AI based learning provides students with direct experience in exploring the concepts. Through interactive learning activities, students can better understand how AI systems process information and generate outputs [28]. These experiences are expected to enhance students' conceptual understanding of AI.

- H2: Teacher guidance positively influences students' knowledge of AI.
  Teacher guidance plays an important role in facilitating learning, especially when students encounter complex and unfamiliar concepts [29]. Teachers help students interpret information, clarify misconceptions, and connect new knowledge with prior understanding. Therefore, effective teacher guidance is expected to improve students' knowledge of artificial intelligence.
- H3: Students' knowledge of artificial intelligence positively influences technological awareness.
  Students who possess higher levels of knowledge about artificial intelligence are more likely to understand how technology functions and influences various aspects of life [30]. This understanding contributes to broader technological awareness, including the ability to recognize the role of technology in society.
- H4: Technological awareness positively influences students' perceptions of artificial intelligence.
  Students with higher technological awareness are more capable of evaluating the benefits and limitations of artificial intelligence. This awareness allows students to develop more balanced and informed perceptions of AI technologies, leading to more positive attitudes [9, 31].

4. Methodology

4.1. Research Design

This study employed a quantitative descriptive and exploratory design to examine elementary school students' knowledge, awareness, and perceptions of AI following AI based learning activities. The study aims to identify patterns in students' understanding of AI and to explore how cognitive and perceptual aspects relate to each other, without assuming causal relationships.

4.2. Participants and Sampling

The participants consisted of 233 elementary school students in grades five and six who had participated in AI based learning activities using interactive learning modules. A purposive sampling technique was used to select students who had direct exposure to the learning intervention.

4.3. Data Collection Instruments

Data were collected using structured questionnaires and knowledge based test items. The instrument consisted of ten items designed to assess students' understanding of AI concepts, awareness of AI in daily life, and perceptions of AI technologies.

Each item was presented in multiple choice format with four response options. The responses were coded into numerical values using an ordinal scale, where higher values represent more accurate or appropriate understanding.
To facilitate construct level analysis, the items were grouped into three constructs:

- Knowledge, representing students' understanding of basic AI concepts
- Awareness, reflecting students' recognition of AI presence and applications in daily life
- Perception, indicating students' views and attitudes toward AI

4.4. Data Analysis

The data were examined using descriptive measures alongside correlation analysis. Student responses were first expressed in numerical form based on a four point scale, allowing a general pattern to be observed. From this, mean values and standard deviations were obtained to give an overview of how the three constructs appear across the dataset.

Next, correlation analysis was conducted to examine the relationships among knowledge, awareness, and perception. This analysis was intended to identify patterns of association among the constructs rather than to test causal relationships.

4.5. Data Transformation Procedure

Since the original responses were categorical, an expected value approach was applied to transform aggregated response data into numerical scores. Each response category was assigned a score ranging from 1 to 4, and mean values were calculated to represent students' overall performance on each construct.
This approach allows for structured quantitative interpretation while maintaining transparency in data transformation.

4.6. Research Limitations

The study has several limitations that should be taken into account. Some relate to the measurement itself. The instruments used here were not originally developed as standardized scales for latent variable modeling, so the way the constructs are represented may be somewhat constrained. There are also parts of the model that could not be examined directly. Variables such as AI learning effectiveness and teacher guidance were not included in the dataset, which leaves those aspects only partially addressed. In addition, the analysis relies on correlation. This means the results point to patterns in the data, but they do not indicate causal relationships.

5. Results and Discussion

5.1. Descriptive Overview of Students' AI Understanding

A total of 233 valid responses were analyzed to examine students' understanding of AI concepts after participating in AI based learning activities. The construct level analysis indicates that students demonstrate the highest performance in the knowledge dimension (M = 3.05, SD = 0.47), followed by perception (M = 2.30, SD = 0.53) and awareness (M = 2.30, SD = 0.67).

The results point to a pattern that is not entirely uniform. Students seem able to recognize basic ideas about AI, especially when dealing with familiar functions such as machine learning or simple system behavior. This part appears relatively clear. The picture changes, however, when awareness and perception are considered. The scores are lower, and the responses suggest that these aspects are not yet as well developed. In other words, students may understand certain concepts, but this understanding does not always extend to how AI is seen in broader contexts. Similar tendencies have been noted in earlier studies, where initial exposure supports conceptual learning, while more reflective or contextual understanding takes longer to emerge.

5.2. Distribution of Responses

The distribution of students' responses to AI related items is presented in Table 1.

Table 1.
Distribution of Students' Responses on AI Related Concepts.

Item	A	B	C	D
Robot can learn independently	154	54	18	7
Shape of robot	51	0	4	178
Source of information about robots	74	0	69	90
Human vs computer intelligence	59	42	122	10
Awareness of AI term	78	76	49	30
Robot presence in daily life	108	15	24	86
Imagination about robots	7	130	58	38
Computer can have AI	138	33	22	40
Benefits of robots	11	1	203	18
Robots replacing jobs	20	164	25	24

Note: A = Most accurate answer; B = Moderately accurate answer; C = Less accurate answer; D = Incorrect answer.

Looking at the response pattern, students seem more certain when answering items that deal with basic AI functions, such as how systems process information or recognize patterns. The situation changes when the questions move toward broader issues, including the role of robots or their possible impact on human activities, where the answers appear more scattered. This difference may suggest that students are able to grasp fundamental ideas, yet this understanding does not always carry over when they are asked to think about how those ideas relate to real situations.

5.3. Construct Relationships

To examine the relationships among the constructs, correlation analysis was conducted. The results are presented in Table 2.

Table 2.
Correlation Among Constructs.

Variable	Knowledge	Awareness	Perception
Knowledge	1.000	0.017	-0.010
Awareness	0.017	1.000	-0.040
Perception	-0.010	-0.040	1.000

The results indicate that the relationships among the constructs are extremely weak. The correlation between knowledge and awareness is 0.017, while the relationship between knowledge and perception is -0.010. Similarly, the correlation between awareness and perception is -0.040.

These findings indicate that students' knowledge of AI does not significantly relate to their awareness or perception. The results do not provide empirical support for the proposed relationships among the constructs. However, they reveal an important pattern in which cognitive understanding develops independently from broader awareness and evaluative perspectives. This finding aligns with previous studies suggesting that knowledge acquisition alone is insufficient to shape students' attitudes toward AI [32-34].

5.4. Discussion

The study was initially designed to examine the influence of AI based learning on students' knowledge. However, the current dataset does not include a direct measure of AI learning effectiveness, which limits the ability to test the first hypothesis empirically. Despite this limitation, the relatively high mean score in the knowledge construct indicates that students were able to develop a basic understanding of AI concepts following the learning activities.

The findings provide important insight into how elementary students develop understanding of AI. Although students demonstrate relatively strong conceptual knowledge, this understanding does not extend to higher levels of awareness or more developed perceptions. The extremely low correlation values among the constructs suggest that knowledge, awareness, and perception operate as relatively independent dimensions rather than as a unified developmental process [26, 35].

This result challenges the common assumption that increasing knowledge will automatically lead to improved awareness and more positive perceptions [36]. Instead, the findings indicate that conceptual understanding alone is insufficient to shape how students interpret and evaluate AI [5, 37]. Students may recognize how AI systems function, but they do not necessarily develop a deeper understanding of their implications or form stable attitudes toward their use.

If this situation is considered from an educational point of view, it seems to point to a limitation in how AI based learning is currently carried out. In many cases, the emphasis is placed on helping students understand basic concepts, while less attention is given to how these ideas connect to broader ways of thinking or feeling about the technology [38, 39]. A similar pattern can be seen in instructional design, where conceptual understanding is often prioritized, but opportunities to engage with contextual, ethical, or social aspects are more limited. Under these conditions, students may come away with pieces of understanding that do not fully connect, rather than forming a more complete view of AI in relation to wider contexts [40].

The results also point to a difference in how these aspects develop. What seems to work for building basic knowledge may not be enough when it comes to awareness or perception [39]. In practice, students may need learning experiences that allow them to pause, reflect, and relate what they learn to situations they recognize, rather than focusing only on concepts[41, 42]. Activities that involve exploring how AI appears in everyday contexts may help in this regard. Within this process, the role of the teacher becomes important, not so much to deliver information, but to help students make sense of what they encounter and connect it with a more meaningful understanding of technology [43].

Overall, this study contributes to the literature by demonstrating that the relationship between knowledge and perception is not linear or automatic. Instead, it highlights the need for more integrative approaches to AI education that combine conceptual instruction with contextual and reflective learning experiences.

6. Conclusion

This study examined elementary school students' knowledge, awareness, and perceptions of AI following AI based learning activities. The findings indicate that students demonstrate relatively strong understanding of basic AI concepts, while their awareness and perceptions remain at a moderate level. This suggests that students are able to recognize fundamental aspects of AI, but have not yet developed a comprehensive understanding of its broader implications.

The analysis also reveals that the relationships among knowledge, awareness, and perception are very weak. This indicates that increased conceptual understanding of AI does not automatically lead to higher awareness or more developed perceptions. These findings highlight a gap between cognitive and perceptual dimensions in early AI learning.

From an educational perspective, the results suggest that AI based learning should not focus solely on conceptual knowledge. Instead, instructional approaches need to incorporate contextual, reflective, and real world elements to support the development of students' awareness and perceptions. Learning experiences that include discussion, practical applications, and guided exploration may help bridge this gap.

This study contributes to the field of AI in education by providing empirical evidence that knowledge alone is not sufficient to shape students' perceptions of AI. However, the study is limited by the scope of the measurement instruments and the absence of variables related to instructional design and teacher support. Future research is recommended to develop more comprehensive measurement models, include additional variables, and apply more advanced analytical methods to further explore the relationships among cognitive and perceptual dimensions.

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