



## The Effect of Perceptions Toward Artificial Intelligence (AI) And Digital Skills on High School Students' Physics Problem-solving Ability

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### ARTICLE INFO

#### Keywords:

Artificial Intelligence;  
Digital Skills;  
Problem-Solving Skills;  
Physics instruction;

### ABSTRACT

**Purpose** – This study aims to examine the relationship between students' perceptions of Artificial Intelligence (AI) and digital skills and their physics problem-solving abilities. The study specifically investigates the partial relationships between AI perception and problem-solving ability, between digital skills and problem-solving ability, and the simultaneous relationship between AI perception and digital skills and students' physics problem-solving ability.

**Methodology** – This study employed a quantitative correlational design. The sample consisted of 102 students at SMAN 9 Makassar. Data were collected using instruments that measured students' perceptions of AI, digital skills, and physics problem-solving abilities. The data were analyzed using prerequisite tests, including normality, linearity, and multicollinearity tests, followed by multiple linear regression analysis, t-tests, an F-test, and the coefficient of determination. The significance level was set at  $\alpha = 0.05$ .

**Findings** – The results showed that students' perceptions of AI did not have a significant partial relationship with physics problem-solving ability, with a significance value of  $0.689 > 0.05$ . Similarly, digital skills did not have a significant partial relationship with physics problem-solving ability, with a significance value of  $0.737 > 0.05$ . Furthermore, students' perceptions of AI and digital skills were not significantly related to physics problem-solving ability, as indicated by an F-test significance value of  $0.901 > 0.05$ . The coefficient of determination ( $R^2$ ) explained only 0.2% of the variation in students' physics problem-solving ability.

**Contribution** – This study provides an empirical contribution to understanding the relationship among students' perceptions of AI, digital skills, and physics problem-solving ability in the context of high school physics education.

Received 02 August 2026; Received in revised form 10 August 2026; Accepted 01 October 2026

Jurnal Eduscience (JES) Volume 13 No. 5 (2026)

Available online 30 October 2026

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## INTRODUCTION

Physics education at the high school level plays a crucial role in today's digital age, characterized by rapidly evolving, increasingly complex technology. These changes have had a significant impact on the educational system, which previously emphasized conventional methods but is now transforming toward technology-based learning. The use of information technology in education not only facilitates knowledge transfer but also creates opportunities for more interactive, engaging, and tailored learning experiences for 21st-century students. One technology that has garnered significant attention is Artificial Intelligence (AI), which is considered capable of delivering more personalized, adaptive, and tailored learning experiences to students' learning styles (Fajriati et al., 2024).

According to Ding (2023), using AI as a virtual tutor in physics classes can increase students' engagement, curiosity, and confidence in completing assignments. AI serves not only as a source of information but also as a learning partner that can interact directly, provide suggestions, and help students overcome difficulties in understanding abstract concepts. Henze's (2026) research also confirms that AI-based learning can boost students' intrinsic motivation and emotional engagement through instant feedback, engaging visualizations, and adaptive challenges. Proper integration of AI not only aids in understanding physics concepts but also enhances students' satisfaction with learning and curiosity. In line with developments in digital innovation, previous research has shown that educational technologies, including e-learning, can boost motivation to learn; consequently, students' perceptions of AI use tend to be positive when the technology genuinely supports their individual needs.

Advances in artificial intelligence (AI) in education have required students to possess strong digital skills to adapt to increasingly data- and technology-driven learning. In the context of physics education, digital skills play a crucial role as a bridge between abstract concepts. The OECD (2023) emphasizes that digital skills are among the key 21st-century competencies that determine an individual's readiness to face technological transformation, particularly in critical thinking and problem-solving. In other words, students with strong digital skills will find it easier to understand, evaluate, and apply physics concepts using digital media.

The DigComp 2.2 framework, developed by the European Commission (2022), defines digital competence as the ability to interact confidently, critically, and safely with digital technologies, including AI-driven systems. This indicates that digital skills are not merely the ability to use devices but also encompass conceptual understanding, ethics, and the capacity for reflective thinking when using technology to solve complex problems, such as physics problems. In this context, students with high digital skills will be better able to utilize AI features to analyze experimental data, perform force and energy simulations, and independently identify misconceptions in physics.

Empirically, research shows that digital skills are significantly associated with learning outcomes and higher-order thinking skills. The 2022 PISA results reveal that moderate use of digital technology for learning activities positively impacts students' academic performance, particularly in analytical thinking and problem-solving skills (OECD, 2023). In line with this, UNESCO (2025) emphasizes that digital innovation can "complement, enrich, and transform education" when used appropriately and supported by adequate digital literacy and skills. Thus, digital competence serves as the foundation for students to effectively use AI to understand and solve both conceptual and quantitative physics problems.

In the Indonesian context, the results of the 2023 National Digital Literacy Index show a score of 3.54 (moderate category), indicating that the public's digital skills, including students', still need improvement, particularly in digital ethics and security. Meanwhile, the 2024 Indonesian Digital Society Index (IMDI) recorded a score of 43.34, indicating an improvement that has not yet been evenly distributed across all regions (Kementerian Komunikasi dan Informatika Republik Indonesia, 2025). These findings underscore the critical importance of strengthening students' digital skills in schools so that they not only become passive users of technology but also use it critically to support AI-based physics learning.

Research by Yeyendra (2024) at the high school level shows that most students still have low awareness of digital safety and ethics, even though access to technology is already quite high. This situation limits their

ability to use digital technology for productive learning activities. Meanwhile, the results of Putra's (2024) study, based on a systematic literature review, confirm that integrating digital skills into science learning can enhance students' problem-solving, creativity, and analytical abilities in relation to physical phenomena. Thus, digital skills serve as a mediating factor between positive perceptions of AI and improved physics problem-solving abilities.

Given this century's technological advancements, artificial intelligence (AI) and digital skills have become essential foundations of modern education. However, the success of AI integration is largely determined by students' positive perceptions of this technology and their digital skills. Without these two aspects, the use of AI in learning will be merely a formality and will not significantly improve students' cognitive competencies, particularly their physics problem-solving skills (Ding, 2023). If research on perceptions of AI and digital skills is not conducted and does not result in appropriate learning strategies, a chain reaction of consequences will ensue, including a decline in the quality of the national workforce, an increase in the digital divide, and the loss of a golden opportunity to participate in an innovation-based economy. This situation could widen the gap between developed and developing countries. In the field of physics education, problem-solving skills serve as a bridge to fostering critical thinkers and future technology innovators (Marcel, 2025).

Therefore, this study is of great strategic importance. The findings of this study are expected to provide a scientific basis for the development of educational policies, the design of more effective AI-based learning media, and the improvement of high school students' digital literacy. Thus, Indonesia can strengthen its position in facing the era of the 5.0 industrial revolution, in which critical thinking, problem-solving, and technological literacy are key competencies that determine the nation's competitiveness. The findings of Octaviani's (2025) study indicate that more than 95% of students have used various forms of AI technology in their learning activities, including chatbots, adaptive learning platforms, and digital translation apps. The study also emphasizes that AI provides a learning experience that is flexible, personalized, and relevant to the characteristics of Generation Z, who tend to prefer technology-based learning. Thus, AI has the potential to serve as a bridge, helping students learn independently and with motivation as they tackle challenging physics material.

Based on the above discussion, it can be concluded that perceptions of Artificial Intelligence (AI) technology and digital skills are important factors influencing the success of the learning process, particularly in the mastery of higher-order thinking skills, such as physics problem-solving. A positive perception of AI will encourage students to be more open and active in utilizing technology as a learning resource, while strong digital skills will support the effectiveness of the exploration and problem-solving processes. Therefore, to gain a deeper understanding of the roles of these two factors in the context of physics learning in high school, a study was conducted titled "The Influence of Perceptions of AI and Digital Skills on High School Students' Physics Problem-Solving Abilities."

Based on preliminary observations at SMAN 9 Makassar, Grade 11 students, comprising Physics XI TL 1, Physics XI TL 2, and Physics XI TL 3, still require Artificial Intelligence (AI) as a tool and a support in the physics learning process. The students need AI to assist them in accessing information and supporting their understanding of physics learning materials. In addition, interviews with physics teachers indicated that teachers still require additional references through AI and digital skills to develop more attractive visual learning materials. The use of visual learning materials is expected to increase students' interest and help them understand physics concepts more easily. These preliminary findings indicate the need to examine students' perceptions of AI and digital skills in relation to their physics problem-solving ability at SMAN 9 Makassar. Therefore, this study was conducted to examine the relationship between these variables among Grade 11 students at SMAN 9 Makassar. Based on the background described above, the research questions of this study are formulated as follows:

1. Is there a relationship between students' perceptions of AI and their physics problem-solving ability?
2. Is there a relationship between students' digital skills and their physics problem-solving ability?

3. Is there a simultaneous relationship between students' perceptions of AI and digital skills and their physics problem-solving ability at SMAN 9 Makassar?

This study is expected to provide theoretical, empirical, and practical contributions to physics education at the high school level are (1) contributes to the literature on factors related to students' physics problem-solving ability, particularly students' perceptions of Artificial Intelligence (AI) and digital skills in technology-based learning, (2) provides empirical evidence regarding the relationship between students' perceptions of AI, digital skills, and physics problem-solving ability, both partially and simultaneously, and (3) provide a basis for teachers and schools in designing physics instruction that is adaptive to developments in digital technology and AI. The findings may also support the critical, effective, and responsible use of technology to develop students' ability to solve physics problems.

## METHODOLOGY

### Research Design

The research design was a cross-sectional survey. This design was chosen because the research data were collected at a single point in time using questionnaires and tests, with no treatment or intervention administered to the respondents. This study aims to analyze the effect of perceptions toward Artificial Intelligence (AI) ( $X_1$ ) and digital skills ( $X_2$ ) on physics problem-solving ability ( $Y$ ). The analysis was conducted using multiple linear regression to determine the direction and magnitude of the independent variables' effects on the dependent variable.

The research model used is as follows:

$$X_1 \rightarrow Y$$

$$X_2 \rightarrow Y$$

$$X_1 \text{ dan } X_2 \rightarrow Y$$

The research model indicates that perceptions of Artificial Intelligence (AI) and digital skills are positioned as independent variables that are hypothesized to influence physics problem-solving ability as the dependent variable

### Participant

The population in this study consists of all 11th-grade students at SMAN 9 Makassar who are taking physics during the 2025–2026 school year. Since the researcher could reach the entire population, all members of the population were included as respondents or research samples. Thus, this study used total sampling, meaning all 102 11th-grade students who met the research criteria were included in the data collection.

### Data Collection

The data collection methods used in this study were tailored to the types of variables under investigation, namely students' perceptions of Artificial Intelligence ( $X_1$ ), students' digital skills ( $X_2$ ), and physics problem-solving ability ( $Y$ ). Research data were collected through questionnaires and tests. Questionnaires were used to obtain data on students' perceptions of Artificial Intelligence and their digital skills. The questionnaires were designed as closed-ended statements using a four-point Likert scale, so respondents were asked to select the answer option that best matched their circumstances, experiences, and perspectives in the context of physics learning. Furthermore, tests were used to measure students' physics problem-solving skills. The test consisted of essay-type questions based on Higher Order Thinking Skills (HOTS) that measured students' ability to solve physics problems through the stages of Identify, Set Up, Execute, and Evaluation. Data collection was conducted by administering the questionnaire and test instruments to respondents in accordance with research procedures to obtain data on students' perceptions of AI, digital skills, and physics problem-solving abilities.

**Instrument**

This study employed three research instruments: an AI perception questionnaire, a digital skills questionnaire, and a physics problem-solving test. The AI perception questionnaire ( $X_1$ ) and digital skills questionnaire ( $X_2$ ) were developed by the researchers based on relevant theoretical frameworks and previous empirical studies. The AI perception questionnaire covered perceived usefulness, perceived ease of use, intention to use, and trust, while the digital skills questionnaire comprised access, evaluation, usage, ethics, creativity, collaboration, and digital security. Both questionnaires used a four-point Likert scale, ranging from 1 (strongly disagree) to 4 (strongly agree). Meanwhile, physics problem-solving ability ( $Y$ ) was measured using a HOTS-based essay test developed by the researchers based on the problem-solving framework of Young and Freedman, covering the stages of Identify, Set Up, Execute, and Evaluation.

**Data Analysis**

The data analysis techniques used in this study were prerequisite tests and inferential analysis. Before conducting a multiple linear regression analysis, prerequisite tests were performed to ensure that the data met the assumptions of the regression model. The prerequisite tests in this study included tests for normality, linearity, and multicollinearity. The normality test was performed using the Kolmogorov-Smirnov test. The linearity tests were conducted separately for the relationships between perceptions of AI ( $X_1$ ) and physics problem-solving ability ( $Y$ ), and between digital skills ( $X_2$ ) and physics problem-solving ability ( $Y$ ), with decisions based on the significance of the “Deviation from Linearity” statistic. Next, the multicollinearity test was used to assess whether the independent variables were highly correlated in the regression model. The multicollinearity test was conducted by examining the Tolerance and Variance Inflation Factor (VIF) values. If all the prerequisite tests for the analysis were met, the analysis proceeded to the hypothesis testing stage using multiple linear regression.

Inferential analysis was used to test the effects of perceptions toward AI ( $X_1$ ) and digital skills ( $X_2$ ) on students’ physics problem-solving abilities ( $Y$ ). Multiple linear regression analysis was used because the study involved two independent variables and one dependent variable. Hypothesis testing was conducted using the t-test, F-test, and coefficient of determination.

**FINDINGS**

**Normality and Linearity Tests**

Based on the results of the normality test using the Kolmogorov-Smirnov test, significance values of 0.20 were obtained for the Digital Skills variable, 0.10 for the AI Perception variable, and 0.06 for the Problem-Solving Ability variable. All of these significance values are greater than 0.05, so it can be concluded that the data for all three variables are normally distributed. Thus, the data meet the assumption of normality for further analysis.

**Table 1.** Normality Test of Kolmogorov-Smirnov

| Variables               | Sig. | Description |
|-------------------------|------|-------------|
| Digital Skills          | 0.20 | Normal      |
| AI Perception           | 0.10 | Normal      |
| Problem-Solving Ability | 0.06 | Normal      |

Based on the results of the linearity test, a Deviation from Linearity value of 0.22 was obtained. This value is greater than 0.05 ( $0.22 > 0.05$ ), so there is no significant deviation from linearity between Digital Skills and Problem-Solving Skills. Thus, the relationship between Digital Skills and Problem-Solving Ability satisfies the linearity assumption. As for the results of the linearity test, a Deviation from Linearity value of 0.07 was obtained. This value is greater than 0.05 ( $0.07 > 0.05$ ), so it can be concluded that there is no significant deviation from linearity between AI Perception and Problem-Solving Ability. Thus, the relationship between AI Perception and Problem-Solving Ability satisfies the linearity assumption.

**Table 2.** Linearity Test of ANOVA

| Variables                                 | Linearity                | Mean Square | F    | Sig. |
|-------------------------------------------|--------------------------|-------------|------|------|
| Digital Skill and Problem-solving ability | Deviation from Linearity | 59.04       | 1.34 | 0.22 |
| AI Perception and Problem-solving Ability | Deviation from Linearity | 68.06       | 1.57 | 0.07 |

**Multicollinearity Test**

Based on the multicollinearity test results, the Digital Skills variable has a Tolerance of 0.896 and a VIF of 1.12, and the AI Perception variable has a Tolerance of 0.89 and a VIF of 1.12. The Tolerance values for both variables are greater than 0.10, and the VIF values are less than 10. Therefore, there is no multicollinearity between the Digital Skills and AI Perception variables in the regression model.

**Table 3.** Tolerance Value of Multicollinearity Test

| Variables      | Tolerance | VIF  |
|----------------|-----------|------|
| Digital Skills | 0.89      | 1.12 |
| AI Perception  | 0.89      | 1.12 |

**Multiple Linear Regression Test**

Based on the results of the multiple linear regression analysis, the R value was 0.045, indicating that the relationship between Digital Skills and Perceptions of AI, when considered alongside Problem-Solving Ability, is very weak. The R-squared value of 0.002 indicates that Digital Skills and Perceptions of AI together account for 0.2% of the variation in Problem-Solving Ability, while 99.8% is influenced or explained by other factors outside the variables used in this study.

**Table 4.** Multiple Linear Regression Test

| Variable | R    | R <sup>2</sup> | Adjusted R <sup>2</sup> | R <sup>2</sup> Change | df1 | df2 | Sig. |
|----------|------|----------------|-------------------------|-----------------------|-----|-----|------|
| X        | 0.05 | 0.002          | -0.02                   | 0.002                 | 2   | 99  | 0.91 |

**T-Test**

Based on the partial test results (t-test) in the Coefficients table, the Digital Literacy variable shows a t-value of -0.337 and a significance value of 0.74. Since the significance value of 0.74 exceeds 0.05, it can be concluded that Digital Literacy does not have a significant effect on Problem-Solving Ability. Although the t-value indicates a negative relationship, the effect is not statistically significant. Furthermore, the AI Perception variable shows a t-value of 0.401 and a p-value of 0.69. Since the significance value of 0.69 exceeds 0.05, AI Perception also does not have a significant effect on Problem-Solving Ability. Thus, considered individually, neither Digital Literacy nor AI Perception has a significant effect on Problem-Solving Ability at the 5% significance level.

**Table 5.** Digital Skills and AI Perception Effect on Problem-Solving Ability

| Variables      | Sig. |
|----------------|------|
| Digital Skills | 0.74 |
| AI Perception  | 0.69 |

**F-Test**

The simultaneous effect of Digital Skills and Perceptions of AI on students' Problem-Solving Ability was examined using the F-test. This test was conducted to determine whether the two independent variables jointly have a significant effect on students' Problem-Solving Ability. Based on the F-test results, the F-value was 0.104, with a significance level of 0.901. Since the significance level is greater than 0.05 (0.901 > 0.05), it can be

concluded that Digital Skills and Perceptions of AI do not have a significant effect on Problem-Solving Ability simultaneously. Thus, the hypothesis stating that Digital Skills and AI Perception together influence Problem-Solving Ability is not supported.

**Table 6.** Simultaneous Relationship Between Digital Skills and Perceptions of AI Effect on Problem-Solving

| Anova      | Sum of Squares | df  | Mean Square | F    | Sig. |
|------------|----------------|-----|-------------|------|------|
| Regression | 10.25          | 2   | 5.13        | 0.10 | 0.90 |
| Residual   | 4862.54        | 99  | 49.12       |      |      |
| Total      | 4872.79        | 101 |             |      |      |

## DISCUSSION

### The Relationship Between Students’ Perceptions of AI and Problem-Solving Ability: A Partial Analysis

Based on the t-test results, the AI Perception variable had a significance value of 0.689. Since this value exceeds the significance level of 0.05 ( $0.689 > 0.05$ ), students’ perceptions of AI do not have a significant effect on their problem-solving ability in this specific context. This finding indicates that, in the context of this study, a more positive perception of AI is not automatically associated with students’ ability to solve physics problems; this is consistent with findings that positive attitudes or perceptions toward AI do not always directly lead to significant improvements in learning outcomes or gains without targeted instructional design, AI literacy, and high-quality use (Mirza et al., 2025; Robledo-Rella et al., 2024; Schicchi et al., 2026).

The results indicate that a positive perception of AI does not necessarily translate into better physics problem-solving skills for students. Perception refers to how students view the benefits, ease of use, trustworthiness, and applications of AI, whereas problem-solving ability is a cognitive skill that involves understanding a problem, determining a strategy, implementing a solution, and evaluating the results. Therefore, a positive perception of AI does not automatically mean that students can use AI as a tool to develop their thinking processes when solving physics problems.

These findings align with research on students’ perceptions of ChatGPT. Recent studies indicate that college students generally view ChatGPT as a useful tool for learning, but its benefits are limited by concerns about accuracy, ethics, and the need for guided use in academic contexts (Cao et al., 2025; Klimova et al., 2025). In line with this, a meta-analytic synthesis also confirms that ChatGPT’s impact on learning outcomes is stronger when its use is mediated by instructional design and faculty facilitation, rather than simply being available to students as a technology (Ayhan, 2026). This is relevant to the findings of this study because perceptions of AI alone are insufficient to foster problem-solving skills unless accompanied by AI literacy, self-regulation, and appropriate learning strategies. Furthermore, students’ acceptance of AI is influenced by task-technology fit and learning support; therefore, positive perceptions of “AI” need to translate into usage practices that align with the objectives of learning tasks (Aldraiweesh et al., 2025; Du et al., 2024).

Recent research shows that students’ perceptions of AI, particularly ChatGPT, tend to be ambivalent and context-dependent, as perceived benefits often go hand in hand with concerns about dependency, ethics, and the quality of use (Gunawan et al., 2024; Panggabean et al., 2025). A study of college students in China reported that students view ChatGPT as useful, but their experiences and perceptions are still shaped by the tool’s limitations and the context of its use (Panggabean et al., 2025). Cross-national findings involving 23,218 college students from 109 countries also indicate that ChatGPT is perceived as useful for simplifying information and improving learning efficiency, although its benefits are considered more limited for skills that require judgment, such as decision-making and critical thinking (Amin et al., 2026; Tjahjana et al., 2026). Thus, the results of the study at SMAN 9 Makassar indicate that students’ perceptions of AI are not yet a factor directly related to their physics problem-solving skills. The use of AI to improve problem-solving likely requires other abilities, such as evaluating AI-generated answers, formulating appropriate questions or prompts, understanding physics concepts, and thinking critically.

These findings also do not imply that AI cannot enhance problem-solving skills. Recent research indicates that structured AI literacy instruction – particularly through project-based learning – can strengthen students' ability to apply AI concepts to solve real-world problems while supporting the development of metacognitive strategies (Kong et al., 2025; Yifan et al., 2025; Zhu et al., 2026). The difference lies in the context: those studies examined structured AI learning interventions, whereas this study treats students' perceptions of AI as a predictor variable, so the mechanisms being tested are not the (H. Li et al., 2025). Thus, the first research question is answered: there is no significant relationship between students' perceptions of AI and their problem-solving skills, and this result is consistent with the literature indicating that improvements in these skills generally occur when AI is present as part of an intentional instructional design, rather than merely as an object of perception (Balakayeva et al., 2026; Lavado, 2025; Ruiz Viruel et al., 2025) .

### **The Relationship Between Digital Skills and Physics Problem-Solving Ability: A Partial Analysis**

Based on the t-test results, the Digital Skills variable has a significance value of 0.737. This value is greater than 0.05 ( $0.737 > 0.05$ ). Therefore, it can be concluded that Digital Skills are not significantly related to or do not significantly influence Physics Problem-Solving Ability in a partial sense. The results indicate that students with higher digital skills do not necessarily have stronger physics problem-solving abilities. This may be because digital skills and problem-solving abilities are two distinct competencies. Digital skills are more closely related to students' ability to access, use, manage, and utilize technology and digital information, whereas physics problem-solving requires conceptual understanding, mathematical skills, reasoning, problem-solving strategies, and evaluation of solutions.

Other studies show that digital technology tends to support problem-solving when its use is not merely as a tool but is integrated with relevant learning activities, tasks, and pedagogical strategies (Anselmo et al., 2024; Laumann et al., 2024; Ninković et al., 2023). For example, reported that students' physics problem-solving skills remain relatively low, and it is recommended that Problem-Based Learning, supported by 3D digital modules, be implemented as an alternative to strengthen these skills. These findings align with more recent evidence that virtual simulations, virtual laboratories, and digital learning tools in physics can improve learning outcomes, conceptual understanding, and higher-order thinking skills when integrated with constructivist or inquiry-based approaches (Ronilo Palle Antonio et al., 2023; Setyawarno et al., 2026; Syahwin et al., 2022). Meanwhile, studies on blended learning also indicate that combining digital and face-to-face learning can strengthen physics problem-solving skills through contextual tasks, diverse learning resources, interactive visual support, collaboration, and systematic organization of learning (Laumann et al., 2024; Binar Kurnia Prahani et al., 2022; Susilawati et al., 2022).

This shows that simply having or mastering digital technology does not automatically improve problem-solving skills. Technology needs to be used in learning activities that are specifically designed to train students to solve problems. Students may be able to use digital devices, search for information, use apps, or access the internet, but these skills are not necessarily applied to the systematic analysis of physics problems. Therefore, the lack of a significant relationship between digital skills and problem-solving ability in this study suggests that students' digital skills have not yet been directly translated into physics problem-solving strategies. Thus, the second research question is answered: there is no significant relationship between digital skills and physics problem-solving ability, at least in part. Other studies indicate that digital technology tends to support problem-solving in physics learning when it is not merely used as a tool but is integrated with learning activities, task structures, and relevant pedagogical strategies (Anselmo et al., 2024; Ronilo P. Antonio et al., 2023). In the context of physics, this effectiveness also depends on how the technology is orchestrated as an epistemic resource to foster conceptual reasoning and connections between representations, rather than merely serving as a visual medium (Caner, 2026; Fadillah et al., 2026).

## The Relationship Between Perceptions of AI and Digital Skills and Simultaneous Physics Problem-Solving Ability

Based on the F-test results, the significance value was 0.901. This value is greater than 0.05 ( $0.901 > 0.05$ ). Thus, it can be concluded that AI Perception and Digital Skills, when considered simultaneously, do not have a significant relationship with or influence on students' Physics Problem-Solving Skills. The results indicate that when AI Perception and Digital Skills are included together in the regression model, neither variable makes a significant contribution to physics problem-solving ability. This finding makes sense because physics problem-solving ability is more closely related to conceptual mastery, heuristic strategies, cognitive load management, and metacognition than to mere perceptions of technology (Maries et al., 2023). Furthermore, increased motivation or engagement through digital technology does not necessarily lead to improved physics problem-solving ability, as its impact depends heavily on the quality of instructional design and implementation (Pečiuliauskienė, 2023; Tuyizere et al., 2023). This is supported by an R-squared value of 0.002, meaning that AI Perception and Digital Skills together account for only 0.2% of the variation in physics problem-solving ability. Meanwhile, 99.8% of the variation in problem-solving ability is explained by other factors not included in this study's model.

The low coefficient of determination indicates that students' physics problem-solving ability is a complex skill that cannot be adequately explained solely by students' perceptions of AI and digital skills. This ability is likely related to various other factors, such as mastery of physics concepts, mathematical ability, critical thinking skills, problem-solving strategies, learning experiences, motivation, instructional models, metacognitive skills, and the learning environment. Recent literature supports this view: metacognitive skills, particularly monitoring and regulation, have been shown to be significant predictors of physics problem-solving ability (Wider et al., 2023), while other studies indicate that metacognitive knowledge and monitoring play a crucial role, especially in complex physics tasks (Dulger et al., 2025). From an affective perspective, emotional regulation also influences how students perceive physics problem-solving tasks and their persistence in tackling them (Panjaitan, 2025), while broader cognitive-affective factors such as motivation, self-regulation, learning support, and self-belief are also associated with students' learning performance (J. Li et al., 2023).

These findings are consistent with studies showing that students' physics problem-solving skills generally still need to be strengthened and can develop more effectively when supported by structured and innovative learning strategies, particularly through problem-based learning and the integration of relevant media or learning contexts (Gumisirizah et al., 2024; Panda et al., 2025). In the literature, improvements in problem-solving skills depend not only on practice problems but also on instructional designs that intentionally train students to understand problems, select strategies, and evaluate solutions (Prahani et al., 2021; Simanjuntak et al., 2021).

On the other hand, recent systematic reviews indicate that improvements in problem-solving skills in physics learning are influenced by various aspects of learning, including the instructional strategies employed, forms of scaffolding, metacognitive support, as well as the design of media and technology accompanying the learning process (Gou et al., 2026; Musengimana et al., 2025). These findings support the understanding that problem-solving ability is a multidimensional construct and does not depend on just one or two variables; even at the high school level, metacognition, the quality of problem-solving strategies, and the context of learning implementation all contribute to student (Musengimana et al., 2025; Wider et al., 2023).

The findings of this study should also be understood in the context of AI development. In line with recent systematic reviews, the use of ChatGPT in education shows potential to enhance engagement, access to feedback, and personalized learning (Ali et al., 2024; Isiaku et al., 2024). However, the same literature also emphasizes that these benefits cannot be directly equated with an improvement in great problem-solving skills, particularly because issues such as answer accuracy, bias, overreliance, and the need for AI literacy and critical verification by students still persist (Kasneci et al., 2023; Lo, 2023). In the context of physics, this

becomes even more important because studies of ChatGPT-4's performance on physics problems show significant improvement but also underscore the need to adjust learning and assessment strategies to ensure students' reasoning abilities remain truly measurable (Tong et al., 2024). In other words, the results of this study do not contradict the possibility that AI can aid learning. In fact, the findings suggest that simply having an understanding of AI and digital skills is not sufficient to explain students' physics problem-solving abilities. AI and digital technology are likely to provide greater benefits when used as part of structured learning, such as through problem-based learning, project-based learning, simulations, virtual experiments, or activities that require students to evaluate and justify their solutions. Thus, the third research question is answered: there is no significant simultaneous relationship among AI Perception, Digital Skills, and students' Physics Problem-Solving Skills at SMAN 9 Makassar.

## CONCLUSION

Based on the results of the study on the relationship between students' perceptions of Artificial Intelligence (AI), digital skills, and physics problem-solving ability at SMAN 9 Makassar, it can be concluded that students' perceptions of AI do not have a significant relationship with physics problem-solving ability when analyzed partially, as indicated by a significance value of  $0.689 > 0.05$ . Similarly, digital skills are not significantly related to physics problem-solving ability when analyzed separately, with a significance value of  $0.737 > 0.05$ . Furthermore, the simultaneous analysis shows that students' perceptions of AI and digital skills are not significantly related to physics problem-solving ability, as indicated by an F-test significance value of  $0.901 > 0.05$ .

The contribution of the two independent variables is also very small. The R-squared value of 0.002 indicates that students' perceptions of AI and digital skills together explain only 0.2% of the variation in physics problem-solving ability, with the remaining 99.8% attributable to other factors beyond the variables examined in this study. Thus, the contribution of perceptions of AI and digital skills to students' physics problem-solving ability is very limited in this study. These findings indicate that students' perceptions of AI and digital skills have not emerged as significant factors associated with physics problem-solving ability among students at SMAN 9 Makassar. Therefore, other factors beyond the variables examined in this study may need to be considered in understanding students' physics problem-solving ability.

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