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ORIGINAL RESEARCH ARTICLE

AI Literacy and Science Self-Efficacy as Predictors of Senior High School Students' Perceived Scientific Research Skills

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ABSTRACT

The increasing use of artificial intelligence (AI) in education underscores the need to understand how AI literacy and science self-efficacy relate to students' research capabilities. This study examined senior high school students' perceived levels of AI literacy, science self-efficacy, and scientific research skills in Lupon West District, Davao Oriental, Philippines. It aimed to assess whether AI literacy and science self-efficacy uniquely predict scientific research skills. The study employed a cross-sectional predictive-correlational design, involving 261 Grade 12 students selected through proportionate stratified random sampling, with simple random selection within each school. Data were collected using paper-and-pencil questionnaires comprising three adapted instruments. Students reported moderate AI literacy (M = 3.22, SD = 0.65) and science self-efficacy (M = 3.39, SD = 0.71), but high perceived scientific research skills (M = 3.53, SD = 0.70). AI literacy was positively correlated with perceived scientific research skills, r(259) = .62, p < .001, as was science self-efficacy, r(259) = .79, p < .001. The regression model was significant, F(2,258) = 224.66, p < .001, explaining 63.5% of the variance in perceived scientific research skills. AI literacy (B = 0.19, β = .17, p < .001) and science self-efficacy (B = 0.67, β = .67, p < .001) each made significant unique statistical contributions, with science self-efficacy having the larger standardized coefficient. These findings may inform research instruction by integrating responsible AI use and creating opportunities to enhance students' confidence in science.w

Keywords: *Artificial intelligence literacy, science self-efficacy, scientific research skills, senior high school students, science education*

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INTRODUCTION

Scientific research skills enable students to formulate questions, locate and evaluate evidence, select appropriate methods, analyze data, and communicate defensible conclusions. Information-seeking and methodological skills are key components of research preparation because they support identifying relevant evidence and planning and conducting investigations (Meerah et al., 2012). Developing these skills requires more than following prescribed procedures; students must also exercise critical judgment, justify their decisions, and recognize the limitations of their findings. At the senior high school level, research instruction provides opportunities to practice these processes in preparation for further education and evidence-based problem solving. Understanding the factors associated with students' research skills can therefore help identify areas where instructional support is needed.

In the Philippines, research and inquiry are central to the K to 12 curriculum. Republic Act No. 10533, or the Enhanced Basic Education Act of 2013, emphasizes preparing students for higher education, employment, and lifelong learning through inquiry-based approaches. At the senior high school level, Practical Research 1 and Practical Research 2 are intended to develop students' ability to conduct systematic investigations and communicate their findings (Department of Education, 2019). Nevertheless, students often struggle to formulate research problems, justify methodological choices, and interpret results (Mabborang, 2025; Servado, 2024). These difficulties indicate a continuing gap between curricular expectations and students' research competencies.

The growing integration of artificial intelligence (AI) technologies into education introduces additional opportunities and challenges for research learning. AI tools can support information retrieval, data organization, idea development, and academic writing, but their educational value depends on students' ability to use them critically and responsibly. AI literacy extends beyond operating tools to encompass conceptual understanding, critical evaluation, ethical awareness, and responsible engagement with AI technologies (Tadimalla and Maher, 2025). In K–12 education, Casal-Otero et al. (2023) noted limited assessment of students' understanding after AI learning experiences and emphasized the need for coherent, competency-based curricula and teacher involvement. Similarly, Roe et al. (2026) found that university students and academic staff

viewed generative AI feedback more positively when combined with instructor feedback than when provided independently. Recent reviews likewise emphasize teacher preparedness and digital literacy in technology-supported learning (Montejo et al., 2026), alongside safeguards against overreliance on generative AI to preserve independent thinking (Vidanage et al., 2026). Xiao et al. (2024) also identified a positive association between AI literacy and educational attainment in online higher education. Although these studies examined different populations and outcomes, they provide context for investigating the relationship between AI literacy and perceived scientific research skills among senior high school students.

UNESCO's AI Competency Framework for Students (Miao et al., 2024) provides a broader educational context for understanding AI literacy. It identifies four competency dimensions: a human-centered mindset, AI ethics, AI techniques and applications, and AI system design. These dimensions emphasize critical judgment, ethical awareness, and responsible engagement with AI. They provide useful context for considering students' evaluation of AI-generated information, source verification, and accountability for research decisions. In the present study, this framework informs the educational interpretation of AI literacy, while its measurement is based on the Meta AI Literacy Scale developed by Carolus et al. (2023).

Technological competence alone, however, may not ensure effective research performance of students. Science self-efficacy, the belief in one's capability to perform science-related tasks, caninfluence whether students initiate, persist in, and complete chalenging research activities. Students with stronger science self-efficacy tend to approach scientific problems with greater confidence, sustain effort when difficulties arise, and revise their strategies when necessary (Hu et al., 2022; Sahin and Ates, 2020). In the Davao Region, Aguilon and Guhao (2024) examined student self-efficacy alongside teaching-related factors in a model of senior high school academic success. Although their outcome differed from scientific research skills, their study provides regional context for examining confidence-related beliefs in education. Similarly, Roquero et al. (2025) examined AI utilization and study attitude among mathematics education students in Davao de Oro. They found that AI utilization did not significantly mediate the relationship between study attitude and mathematics achievement. Kim et al. (2024) additionally identified student characteristics and school resources associated with science self-efficacy, indicating the relevance of bothpersonal beliefs and the learning environment. Conversely, those with lower self-efficacy may avoid difficult tasks or rely too heavily on external assistance, limiting opportunities to develop independent research skills.

Bandura's Social Cognitive Theory explains learning through reciprocal interactions among personal factors, behavior, and environmental conditions (Bandura, 1986). Within this framework, self-efficacy influences learners' motivation, effort, and persistence when undertaking challenging tasks (Artino, 2012; Bandura, 1997). Guided by this perspective, the present study examines AI literacy and science self-efficacy as potentially complementary personal resources associated with perceived scientific research skills. AI literacy represents students' perceived capacity to understand, evaluate, and use AI, while science self-efficacy concerns their confidence in performing science-related tasks. AI literacy may support critical information use and responsible engagement with research tools, whereas science self-efficacy may support sustained effort during demanding research activities. Accordingly, the regression model examines whether each construct uniquely explains variation in perceived scientific research skills when the other is held constant. The present study assesses statistical associations without establishing causation or testing the theory's full reciprocal relationships.

Although AI literacy and science self-efficacy have each been associated with learning outcomes, limited Philippine research has examined their joint predictive contributions to perceived scientific research skills among senior high school students. Examining these variables together in Lupon West District, Davao Oriental, Philippines, can provide context-specific evidence on whether each contributes uniquely to explaining variation in students' perceived scientific research skills.

This study therefore determined senior high school students' perceived levels of AI literacy, science self-efficacy, and scientific research skills in Lupon West District. It also examined the relationships between AI literacy and science self-efficacy and scientific research skills and assessed whether the two factors significantly predicted students' perceived research skills.

MATERIALS AND METHODS

Research design

This study employed a quantitative, cross-sectional, predictive-correlational research design. It determined the levels of AI literacy, science self-efficacy, and scientific research skills among senior high school students. It examined whether AI literacy and science self-efficacy significantly predicted scientific research skills. As a non-experimental study, it examined statistical relationships and predictive contributions without manipulating the variables or establishing causal effects.

Respondents and sampling procedure

The respondents were Grade 12 students enrolled in the school year 2025-2026 from six public senior high schools in Lupon West District, Schools Division of Davao Oriental, Philippines (Figure 1). To be eligible, students had to meet the following inclusion criteria: (1) officially enrolled as Grade 12 students at the time of data collection and (2) had completed Practical Research 1 and Practical Research 2 as part of the Senior High School curriculum. The target sample was calculated from a population of 806 Grade 12 students using Cochran's formula with finite population correction (as described by Bartlett et al., 2001), resulting in 261 respondents. Proportionate stratified random sampling was employed to ensure that each of the six schools was represented according to its share of the total student population. After determining the sample allocation for each school, respondents were selected through simple random sampling. This procedure promoted proportional representation and reduced selection bias.

Research instruments

Data were collected using a structured questionnaire comprising three instruments adapted from published studies. AI literacy and related competencies were assessed using the 34-item Meta AI Literacy Scale (MAILS) developed by Carolus et al. (2023). The instrument includes applying AI, understanding AI, detecting AI, and AI ethics, together with related competencies involving AI creation, problem solving, learning, persuasion literacy, and emotion regulation. Problem solving and learning concern students' perceived capability to manage difficulties when working with AI and keep pace with AI developments, respectively. Persuasion literacy concerns recognizing and managing AI's influence on personal decisions. The original MAILS uses an 11-point response scale ranging from 0 to 10; however, the present study used a five-point response format for consistency across the questionnaires used.

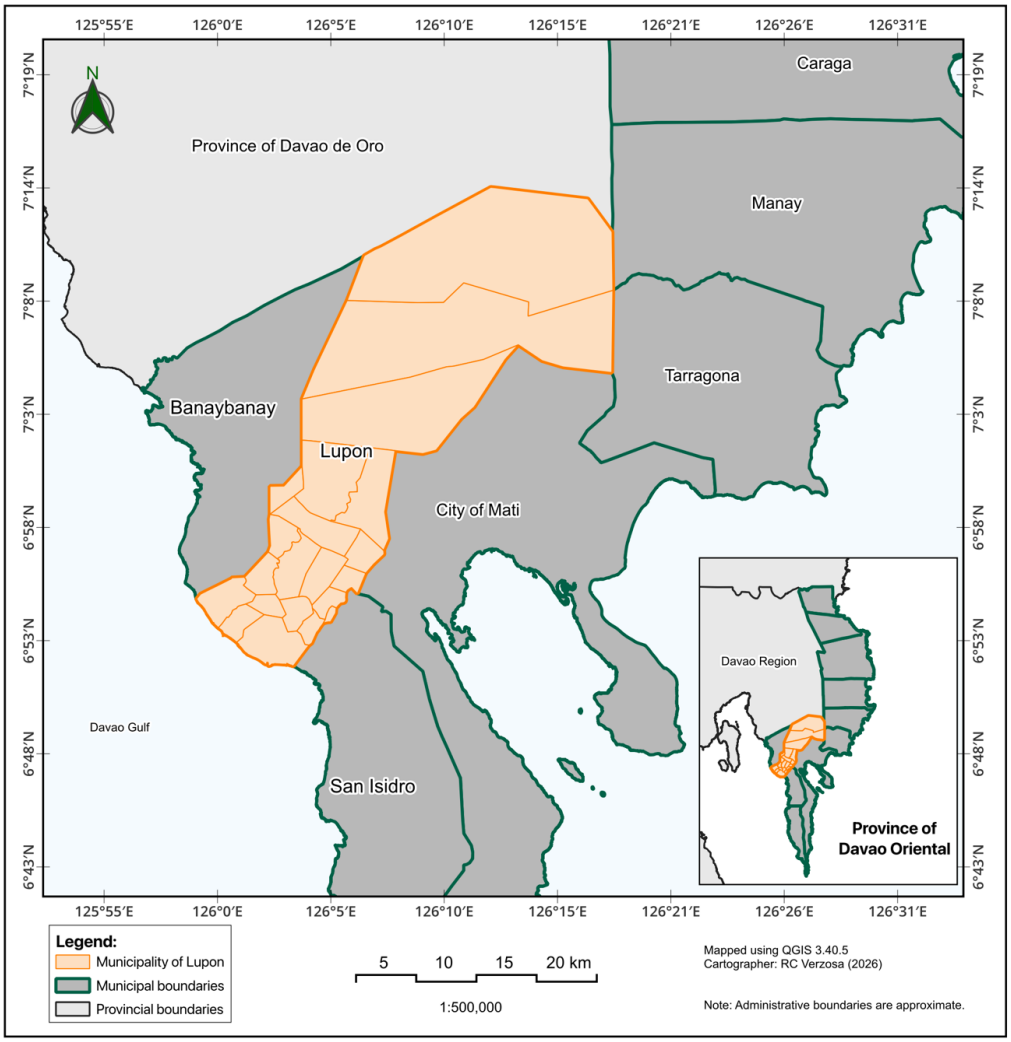


Figure 1. Locator map of the Municipality of Lupon, Davao Oriental, Philippines.

Science self-efficacy was measured using the final 24-item instrument developed by Hu et al. (2022), covering identifying and remembering, explaining and applying, inquiring and arguing, and innovative design. Perceived scientific research skills were assessed using 39 items from Meerah et al. (2012), comprising 26 information-seeking items and 13 methodology items. These instruments assessed students' confidence, research practices, and perceived capabilities rather than independently demonstrated performance. Three experts with postgraduate qualifications and research experience reviewed the questionnaire for relevance, clarity, and suitability. Before the main survey, the questionnaire was pilot-tested with 98 Grade 12 students in Lupon East District, who were excluded from the main study. Internal consistency was evaluated separately for each study measure using Cronbach's alpha. Table 1 presents the coefficients obtained during pilot testing and those recomputed from the main sample.

Table 1. Internal consistency reliability of the study instruments.

Instrument	Items	Pilot α	Main-sample α	Interpretation
AI literacy	34	.95	.95	Excellent
Science self-efficacy	24	.96	.96	Excellent
Scientific research skills	39	.97	.98	Excellent

Note: α = Cronbach's alpha. Pilot coefficients were calculated using the pilot-test sample (n =98); main-sample coefficients were calculated using the 261 study participants.

The coefficients indicated high internal consistency for the study measures in both samples. These estimates describe the consistency of item responses and do not, by themselves, establish construct validity or justify combining distinct dimensions into a single score. All items were administered using a five-point agreement scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. For each respondent, dimension scores were calculated as the arithmetic mean of the items within the corresponding dimension. Overall scores were computed by averaging all 34 AI literacy and related-competency items, 24 science self-efficacy items, and 39 scientific research-skills items, respectively. Individual items therefore received equal weight, while dimensions contributed to the overall score in proportion to their number of items. For exploratory descriptive presentation, the 39 research-skills items were organized into nine content groups within the instrument's

two original domains. Groups were defined according to item content, and each respondent's group score was calculated as the arithmetic mean of its constituent items.

Data collection procedures

The Schools Division Superintendent, Public Schools District Supervisor, and school heads of the participating schools approved the study. The researcher then coordinated with the teachers handling research subjects on the schedule and distribution of the printed questionnaires during February–March 2026. Before data collection, the researcher explained the study's purpose, scope, procedures, voluntary nature, and confidentiality safeguards to the prospective respondents. Written informed consent was obtained from Grade 12 student-respondents of legal age (aged 18 years or older), while student assent and parental consent were secured for minors. Respondents were informed that they could decline participation or withdraw at any time without penalty and that their responses would be used exclusively for research purposes. The questionnaires were administered in printed form. No personally identifiable information was collected, and completed questionnaires were handled securely to protect the respondents' privacy and confidentiality. All 261 selected student-respondents participated in the study.

Data analysis

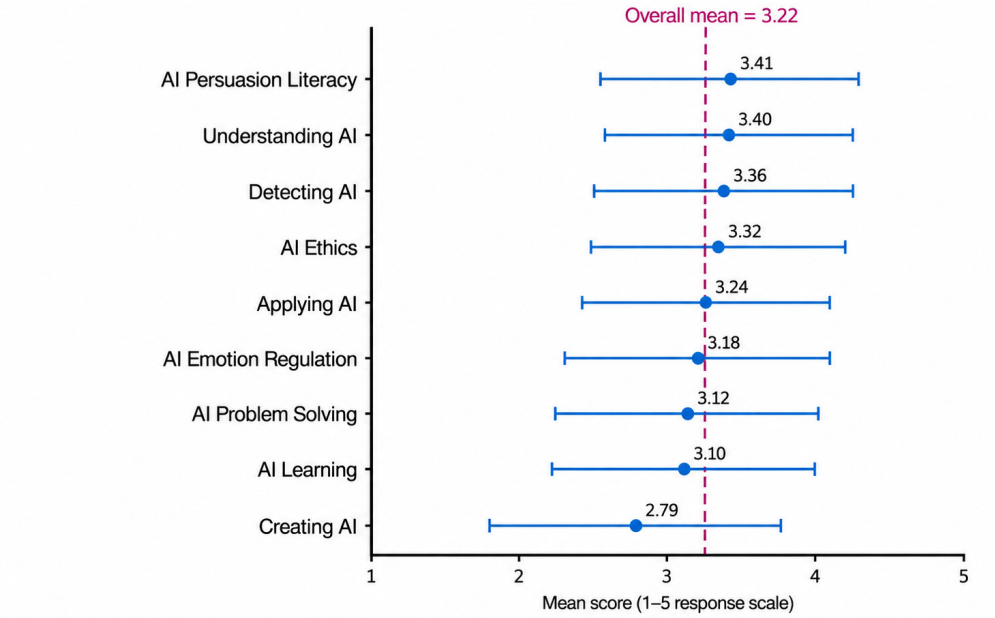
Data were encoded in Microsoft Excel and checked for completeness and valid response ranges before analysis using R version 4.6.1. Means and sample standard deviations were calculated across respondents' composite scores. For descriptive interpretation, means were rounded to two decimal places and classified using the numerical intervals proposed by Pimentel (2019), with verbal labels adapted to the constructs assessed: 1.00–1.79, very low; 1.80–2.59, low; 2.60–3.39, moderate; 3.40–4.19, high; and 4.20–5.00, very high. These categories describe students' self-ratings rather than independently validated proficiency levels. Unrounded scores were used for correlation and regression analyses. Pearson's product–moment correlation coefficient was used to examine bivariate relationships between AI literacy and science self-efficacy and perceived scientific research skills. Multiple linear regression analysis was subsequently performed to determine the unique and combined predictive contributions of AI literacy and science self-efficacy to perceived scientific research skills. Both unstandardized and standardized regression coefficients were reported. Statistical significance was evaluated at $\alpha = .05$.

Before the inferential analyses, the assumptions of linearity, homoscedasticity, residual normality, independence of errors, and absence of problematic multicollinearity were assessed. The dataset contained no missing or out-of-range responses. Diagnostic results indicated no problematic multicollinearity (VIF = 1.82; tolerance = .55), acceptable independence of residuals (Durbin–Watson = 1.92), and no evidence of heteroscedasticity (Breusch–Pagan p = .80). Although the Shapiro–Wilk test indicated a statistically significant departure from residual normality W = .98, p < .001, residual skewness was minimal (.07).

RESULTS

Level of AI literacy

Figure 2 presents students' self-reported AI literacy and related competencies assessed using the adapted Meta AI Literacy Scale. Students had an overall moderate score (M = 3.22, SD = 0.65).



Note. *N = 261*. Points show dimension means; the dashed vertical line marks the overall mean. Horizontal whiskers show ±1 sample SD (standard deviation), not confidence intervals. Labels show means rounded to two decimals. Dimensions are ordered by unrounded means.

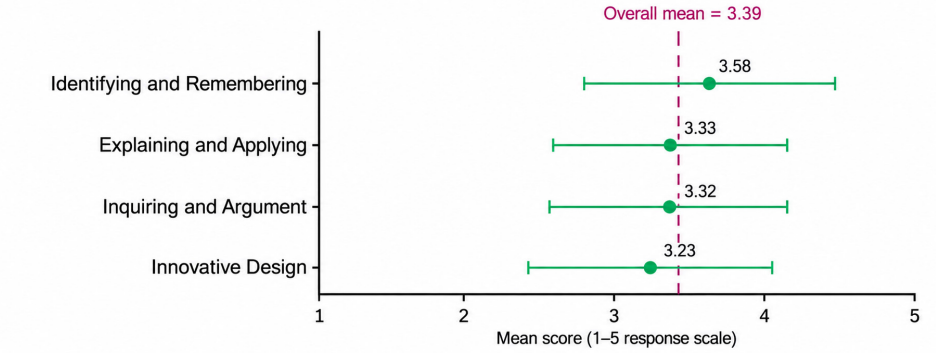
Figure 2. Mean scores for AI literacy and related competencies among senior high school students.

AI persuasion literacy had the highest mean (M = 3.41, SD = 0.86), closely followed by understanding AI (M = 3.40, SD = 0.82). Both dimensions were classified as high. Understanding AI concerns knowledge of AI concepts and capabilities, while persuasion literacy concerns recognizing and managing AI's influence on personal decisions. Creating AI, which involves developing or programming AI applications, received the lowest mean (M = 2.79), although it remained within the moderate range. The remaining dimensions were also reported as moderate. These ratings indicate greater perceived capability in understanding AI and managing its influence than in creating AI applications..

Level of science self-efficacy

Figure 3 presents students' science self-efficacy across four dimensions. Students reported moderate overall confidence (M = 3.39, SD = 0.71) in performing science-related tasks.

Identifying and remembering obtained the highest mean and was the only dimension interpreted as high (M = 3.58, SD = 0.81). This dimension concerns recognizing scientific information, recalling concepts, and describing or classifying familiar phenomena. Explaining and applying (M = 3.33, SD = 0.76),



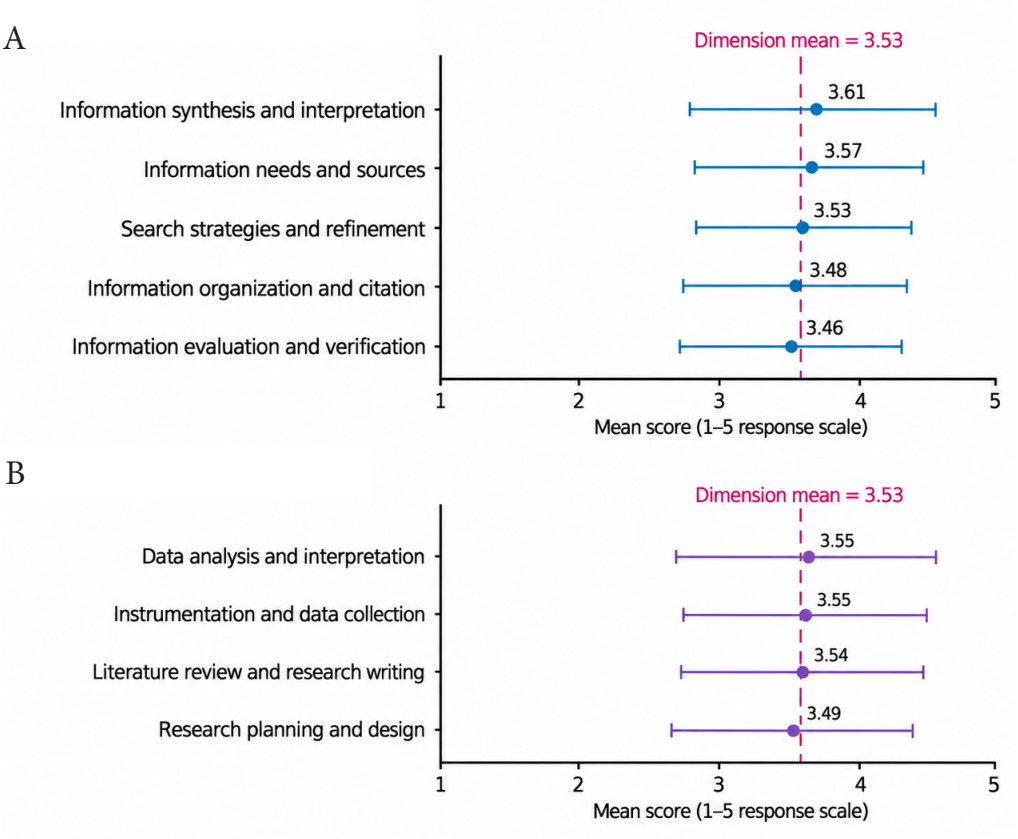
Note. *N* = 261. Points show dimension means; the dashed vertical line marks the overall mean.
Horizontal whiskers show ±1 sample SD (standard deviation), not confidence intervals.
Labels show means rounded to two decimals. Dimensions are ordered by unrounded means.

Figure 3. Mean scores for science self-efficacy among senior high school students.

inquiring and arguing (M = 3.32, SD = 0.78), and innovative design (M = 3.23, SD = 0.82) were moderate. These dimensions involve applying scientific principles, evaluating evidence and planning investigations, and designing or improving practical solutions, respectively. The pattern indicates greater reported confidence in identifying and recalling information than in undertaking tasks involving application, inquiry, and design.

Perceived scientific research skills

Students' perceived scientific research skills are shown in Figure 4. The overall mean fell within the high range (M = 3.53, SD = 0.70). The figure also presents exploratory content groups within the two dimensions, information-seeking and methodology skills.



Note. Points show content-group means; horizontal whiskers show ±1 sample SD (standard deviation).
Dashed lines mark the corresponding original dimension mean, calculated with equal item weighting.
Labels are rounded to two decimals; groups are ordered by unrounded means. Whiskers are not confidence intervals.

Figure 4. Mean scores for perceived scientific research skills among senior high school students in terms of (A) information-seeking skills and (B) methodology skills.

Information-seeking skills (M = 3.53, SD = 0.70) and methodology skills (M = 3.53, SD = 0.81) were both interpreted as high, with identical means when rounded to two decimal places. Information-seeking skills involve locating, evaluating, organizing, and synthesizing information. Methodology skills concern planning research, formulating questions, selecting methods and instruments, collecting and interpreting data, and preparing research reports. Within information-seeking skills, information synthesis and interpretation obtained the highest mean (M = 3.61, SD = 0.84), while information evaluation and verification obtained the lowest (M = 3.46, SD = 0.77). Information needs and sources (M = 3.57, SD = 0.78), search strategies and refinement (M = 3.53, SD = 0.74), and information organization and citation (M = 3.48, SD = 0.78) also fell within the high range. The pattern indicates relatively higher self-ratings for integrating information and drawing conclusions than for evaluating and verifying information.

Within methodology skills, data analysis and interpretation (M = 3.55, SD = 0.94) and instrumentation and data collection (M = 3.55, SD = 0.87) obtained the highest means when rounded to two decimal places. Literature review and research writing (M = 3.54, SD = 0.87) and research planning and design (M = 3.49, SD = 0.85) were also interpreted as high. These results identify descriptive differences in students' perceived research capabilities, with research planning and design receiving relatively lower ratings and data analysis and interpretation showing the greatest variation.

Relationships of AI literacy and science self-efficacy with scientific research skills

Pearson's product–moment correlation was used to examine the relationships between AI literacy and science self-efficacy, including their dimensions, and perceived scientific research skills. Figure 5 summarizes their correlations with information-seeking skills, methodology skills, and overall perceived scientific research skills.

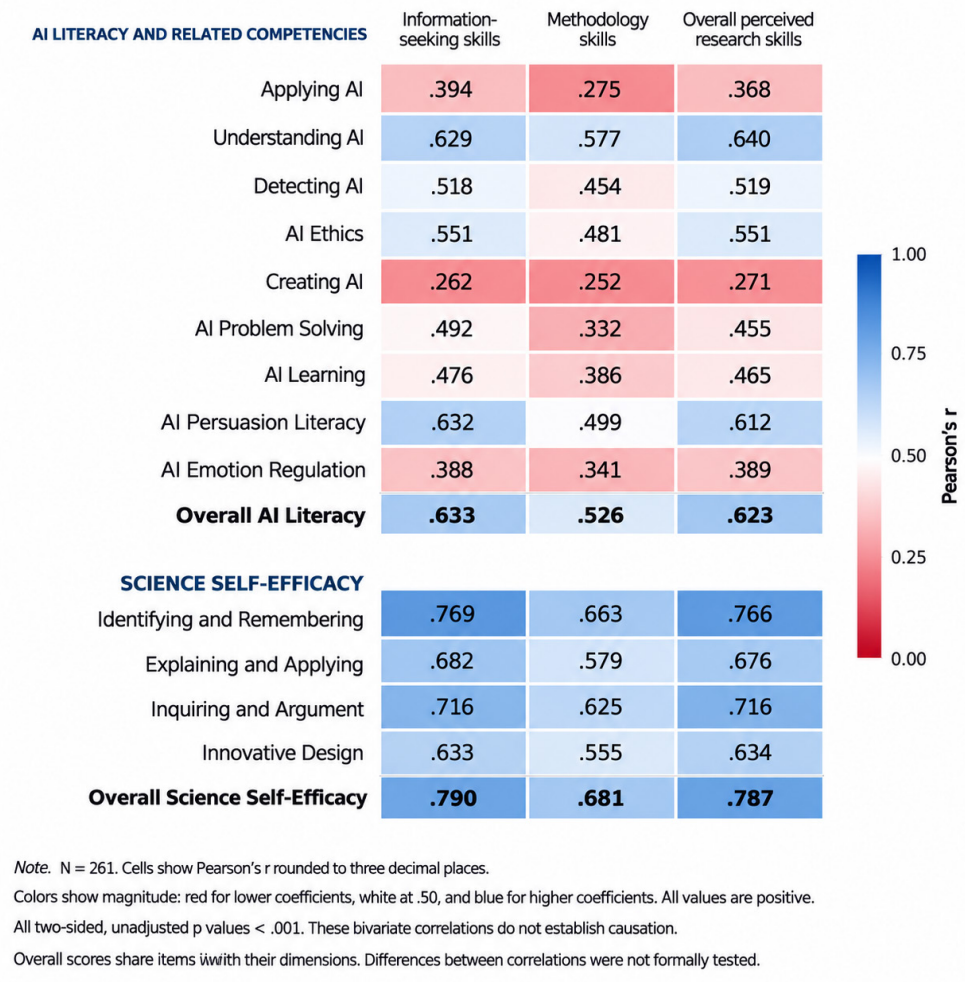


Figure 5. Pearson correlations of AI literacy and science self-efficacy dimensions and overall scores with perceived scientific research skills.

All correlations shown in Figure 5 were positive and statistically significant using two-sided, unadjusted tests (p < .001). Students with higher overall AI literacy and science self-efficacy scores tended to have higher perceived scientific research-skills scores. The overall correlation with science self-efficacy, r(259) = .79, was numerically larger than the correlation with AI literacy, r(259) = .62. Among AI-related dimensions, understanding AI had the largest correlation with overall perceived scientific research skills (r = .64), whereas creating AI had the smallest (r = .27). Among science self-efficacy dimensions, identifying and remembering had the largest correlation (r = .77). These comparisons describe numerical differences between coefficients; the differences were not formally tested.

Both overall measures also showed numerically larger correlations with information-seeking skills than with methodology skills. For AI literacy, the respective correlations were .63 and .53, while those for science self-efficacy were .79 and .68. These bivariate associations reflect students' self-ratings, do not control for other variables, and do not establish causation.

Predictive contributions to scientific research skills

Multiple linear regression was conducted to determine whether AI literacy and science self-efficacy significantly predicted students' perceived scientific research skills (Table 2). The multiple regression model was statistically significant, $F(2, 258) = 224.66$, $p < .001$, and explained 63.5% of the variance in perceived scientific research skills ($R^2 = .64$; adjusted $R^2 = .63$).

Table 2. Multiple regression predicting perceived science research skills.

Predictor	B	SE	β	t	p	95% CI for B
Intercept	0.66	0.14	—	4.6	< .001	[0.37, 0.94]
AI Literacy	0.19	0.06	.17	3.43	< .001	[0.08, 0.29]
Science Self-Efficacy	0.67	0.05	.67	13.23	< .001	[0.57, 0.77]

Note: N = 26. R = .79; $R^2 = .64$; adjusted $R^2 = .63$; $F(2, 258) = 224.66$, $p < .001$.
B = unstandardized regression coefficient; SE = standard error of B; β = standardized regression coefficient; t = t statistic; p = p value; CI = confidence interval.

AI literacy and science self-efficacy each made a significant, unique statistical contribution to explaining variation in scientific research skills as perceived by students. Holding science self-efficacy constant, a one-unit increase in AI literacy was associated with a 0.188-unit increase in perceived research skills. Holding AI literacy constant, a one-unit increase in science self-efficacy was associated with a 0.67-unit increase in perceived research skills. Science self-efficacy had a larger standardized regression coefficient ($\beta = .67$) than AI literacy ($\beta = .17$), indicating a stronger unique association with perceived scientific research skills within the fitted model.

DISCUSSION

Students' moderate AI literacy suggests they are developing readiness to engage with AI, although self-reported scores do not establish their ability to use it effectively in research. Persuasion literacy had the highest mean, followed closely by understanding AI, while creating AI had the lowest. Students therefore perceived themselves as more capable of recognizing persuasive influence of AI and understanding AI than of designing or programming AI applications. This distinction supports examining specific competencies rather than relying solely on an overall score. Koch et al. (2024) distinguish core AI-literacy components from related competencies involving AI creation, self-efficacy, and self-regulation. Classroom instruction could address these different areas through critical evaluation of outputs, ethical reasoning, and appropriately scaffolded opportunities to explore AI development. Almasri's (2024) review likewise highlights both the educational opportunities and implementation challenges associated with AI in science learning.

Students reported moderate science self-efficacy overall. They were most confident in identifying and remembering information, while confidence was lower for explaining and applying concepts, inquiry and argument, and innovative design. Social Cognitive Theory helps explain this pattern: efficacy beliefs are task-specific and become stronger through mastery experiences, modelling, feedback, and manageable challenge (Bandura, 1997; Schunk & DiBenedetto, 2016). Completing science and research courses may build familiarity, but higher-order confidence requires repeated opportunities to design investigations, defend methodological choices, revise unsuccessful procedures, and produce independent solutions.

Students nevertheless reported high scientific research skills, with similar ratings for information seeking and methodology. Completion of Practical Research 1 and 2 may have given them sustained exposure to searching for sources, preparing instruments, gathering data, and writing research reports. Guided and well-sequenced inquiry experiences can help learners develop research competencies (Tonzon, 2023; Vázquez-Villegas et al., 2023). The present ratings reflect perceived competence and may be influenced by confidence, social desirability, or classroom experience. They should therefore be complemented by portfolio assessment, proposal review, data-analysis tasks, and rubric-scored manuscripts to reflect students' demonstrated research performance. The positive relationship between AI literacy and perceived research skills is plausible because AI can support idea generation, information organization, writing, and selected analytical tasks (Khalifa and Albadawy, 2024). Students who perceive themselves as more capable of engaging with AI may consequently feel better equipped to undertake research activities. However, the study did not measure actual AI use during research and cannot establish whether these applications explain the relationship. Responsible engagement also requires critical oversight. Espartinez (2024), examining Philippine higher-education perspectives, emphasizes ethical concerns and the need for institutional support to integrate ChatGPT. Although that population differs from the present sample, the study provides relevant context for recommending source verification, evaluation of generated claims, and clear guidance on acceptable AI assistance.

Science self-efficacy showed a stronger association and a larger standardized regression coefficient. Students who believe they can perform science-related tasks may be more likely to persist when searches fail, revise questions, evaluate conflicting evidence, and troubleshoot research procedures (Artino, 2012; Bandura, 1997). These findings suggest potentially complementary roles for AI literacy and science self-efficacy in research engagement. AI literacy may support critical and responsible engagement with AI tools, which students may use to summarize information and generate ideas (Dang and Nguyen, 2025), while science self-efficacy may support confidence and persistence during research tasks. However, the mechanisms underlying these relationships require further investigation. The model does not establish that improving either predictor leads to better research performance. Unmeasured factors such as teacher support, prior achievement, access to technology and laboratories, reading ability, and research instruction may also shape students' responses.

For senior high schools in Lupon West District, the findings suggest that research instruction could combine responsible AI use with opportunities to build confidence through progressively challenging research tasks. Practical Research activities could require students to verify AI-generated information, justify methodological choices, disclose relevant AI assistance, and defend their conclusions. Teachers could support these activities through modelling, constructive feedback, and opportunities to revise unsuccessful work. School-level guidance could clarify acceptable AI use, academic attribution, and equitable access to learning resources. These instructional implications should be considered within the study's limitations.

The cross-sectional correlational design does not establish temporal ordering or causal relationships among AI literacy, science self-efficacy, and perceived scientific research skills. All three constructs were measured using self-report questionnaires, making the responses susceptible to social desirability, differences in self-evaluation, and common-method variance. The strong association between science self-efficacy and perceived research skills may therefore partly reflect shared confidence-related judgements. The research-skills scores therefore represent perceived competence rather than independently demonstrated performance. The sample comprised Grade 12 students from six public senior high schools in one district, limiting generalization to other settings. Unmeasured factors, including prior achievement, instructional support, and access to research resources, may also contribute to the observed relationships.

Addressing these limitations would help clarify the relationships identified in this study and evaluate the proposed instructional approaches. Future research should include additional districts and school contexts, examine relevant instructional and resource-related factors, and use longitudinal designs to investigate how the constructs change over time. Self-report measures should be complemented by rubric-scored proposals, research portfolios, data-analysis tasks, and completed manuscripts. Intervention studies could then assess whether responsible AI-literacy instruction and mastery-oriented research activities strengthen science self-efficacy and improve independently assessed research performance.

CONCLUSION

Grade 12 students in Lupon West District reported moderate AI literacy and science self-efficacy but high perceived scientific research skills. Both AI literacy and science self-efficacy showed significant unique associations with perceived research skills, with science self-efficacy having the larger standardized regression coefficient. These findings suggest potentially complementary roles for the two constructs in students' perceived research capabilities. The study may inform research instruction that helps students check AI-generated information, complete increasingly challenging research tasks, and improve their work through feedback. For senior high school students, AI may serve as a teacher-guided aid for exploring research ideas, refining preliminary research questions, developing literature-search terms, organizing notes, and improving the clarity of their own writing. Teachers should require students to verify AI-generated information and references, disclose relevant AI assistance, and justify their research decisions. These activities should preserve students' responsibility for their work and provide opportunities to develop confidence and independent scientific judgment. The findings remain specific to perceived competence within the studied context and do not establish that improving either predictor causes better research performance..

ACKNOWLEDGMENT

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AUTHOR CONTRIBUTIONS

M.D.B: Conceptualized the study, conducted data collection, performed data analysis, and prepared the initial manuscript draft. R.C.V. supervised the research, contributed to the study design and methodology, reviewed and edited the manuscript, and provided critical revisions. Both authors read and approved the final version of the manuscript.

DECLARATIONS

Informed consent statement

Written informed consent was obtained from participants aged 18 years or older before data collection. For participants younger than 18 years, parental or guardian consent and student assent were obtained. Participants received information about the study's purpose, procedures, voluntary participation, and confidentiality safeguards.

Conflict of Interest

The authors have no conflict of interest associated with this publication.

AI Declaration

During the preparation of this work, the authors used Elicit for the literature search and Grammarly AI to improve language, readability, and clarity. Following the use of these tools, the authors reviewed and edited the AI-assisted content as needed and take full responsibility for the accuracy and integrity of the article.

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