

Artificial Intelligence Usage and Its Impact on the Problem-Solving Behavior of Grade 11 Mathematics Students

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ABSTRACT

This study examined the relationship between artificial intelligence (AI) usage and the problem-solving behavior of Grade 11 students in mathematics at Bukidnon National School of Home Industries. Specifically, it determined the level of AI usage in terms of reading, writing, and numeracy, and described students' problem-solving behavior in terms of self-confidence, effort, and procedures followed in solving mathematical problems. The study employed a descriptive-correlational research design to investigate the association between the two variables.

Data were collected from 200 Grade 11 students selected through proportional stratified random sampling. The respondents were drawn from the Academic and Technical-Vocational-Livelihood (TVL) strands. The AI usage questionnaire was adapted from Capinding (2024), while the problem-solving behavior instrument was adapted from Bayarcal and Tan (2023). Descriptive statistics such as mean and standard deviation were used to determine the levels of AI usage and problem-solving behavior, while the Pearson Product-Moment Correlation Coefficient was used to determine the relationship between the variables.

The results revealed that students demonstrated a moderate level of AI usage in reading ($M = 3.34$), writing ($M = 3.25$), and numeracy ($M = 3.22$), indicating that AI is commonly used to assist in understanding mathematical texts, improving written explanations, and verifying solutions. Findings also showed that AI tools are often used as supportive learning aids rather than complete substitutes for solving mathematical tasks. Furthermore, the correlation analysis revealed a very weak negative relationship between AI usage and students' problem-solving behavior, suggesting that increased reliance on AI tools may slightly reduce students' independent engagement in mathematical problem-solving processes.

Overall, the findings highlight the growing role of AI technologies in mathematics learning. While AI tools provide instructional support and improve efficiency in completing academic tasks, excessive reliance on them may limit opportunities for students to develop independent reasoning and critical thinking skills. The study recommends that educators guide students in the responsible and balanced use of AI to enhance learning without compromising the development of essential problem-solving abilities.

Keywords: Artificial Intelligence, Problem-Solving Behavior, Mathematics Learning, AI in Education, Senior High School Students

INTRODUCTION

Problem-solving is a fundamental cognitive process that enables individuals to analyze situations, generate solutions, and make informed decisions. In the context of education, problem-solving behavior refers to the strategies, actions, and thought processes students employ when encountering academic challenges. It involves

cognitive skills such as reasoning and analysis, as well as metacognitive and motivational components including planning, persistence, and confidence (Bayarcal & Tan, 2023).

Despite its importance, many Filipino students continue to encounter difficulties in mathematics, particularly in solving problems that require higher-order thinking skills. Results from international assessments such as the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS) have consistently shown that Filipino learners perform below the global average in mathematics, indicating challenges in analytical reasoning and problem-solving abilities.

In recent years, the emergence of artificial intelligence (AI) technologies has significantly influenced educational practices. AI-powered tools such as ChatGPT and Photomath provide students with instant explanations, summaries, and step-by-step solutions to academic tasks. According to Capinding (2024), these tools can support learning by helping students understand complex concepts and verify solutions more efficiently.

However, the increasing accessibility of AI technologies has also raised concerns among educators. Some researchers argue that excessive reliance on AI-generated solutions may reduce students' independent engagement in problem-solving processes and critical thinking activities (Capinding, 2024). Instead of analyzing problems and developing their own strategies, students may become dependent on automated responses.

Given the growing presence of artificial intelligence in education, it is important to examine how AI usage influences students' learning behaviors. Therefore, this study investigates the level of artificial intelligence usage and mathematical problem-solving behavior among Grade 11 students and to examine whether a significant relationship exists between AI usage and students' problem-solving behavior in mathematics.

METHOD

Research Design

This study employed a descriptive-correlational research design to determine the level of artificial intelligence (AI) usage and the problem-solving behavior of Grade 11 students in mathematics, as well as to examine the significant relationship between these two variables. This design was appropriate for addressing the research questions and objectives, as it allows for a systematic investigation of existing conditions and the relationships among variables without manipulating them (Creswell, 2014).

In educational research, the descriptive-correlational design is useful when the goal is to understand how variables interact in real-world settings, particularly when experimental control is not feasible or ethical (Gay, Mills, & Airasian, 2012).

The descriptive component of the design was used to determine and describe the current levels of AI usage and the problem-solving behavior of Grade 11 students of Bukidnon National School of Home Industries in mathematics. This provided a clear baseline understanding of the learners' characteristics and behaviors.

Meanwhile, the correlational component was used to examine whether a statistically significant relationship exists between AI usage and students' problem-solving behavior in mathematics. Identifying the strength and direction of the relationship between these variables contributes to a deeper understanding of how learning tools such as AI influence students' mathematical problem-solving processes (Fraenkel, Wallen, & Hyun, 2019).

Research Respondents

The respondents of this study were the Grade 11 students of Bukidnon National School of Home Industries, Maramag, Bukidnon, who were officially enrolled for the School Year 2025–2026. A total of 200 students served as the targeted respondents, determined using Slovin's formula to ensure an appropriate sample size relative to the population.

This study employed proportional stratified random sampling, a probability sampling technique in which the population is divided into distinct subgroups or strata, and samples are drawn from each stratum in proportion to its size in the population. In this study, the strata were based on the students' academic strands.

Specifically, the sample consisted of 150 students from the Academic strand and 50 students from the Technical-Vocational-Livelihood (TVL) strand. This distribution reflects the actual proportion of students across the two strands within the Grade 11 population. Out of 23 Grade 11 sections, 19 belong to the Academic strand, while 4 sections belong to the TVL strand.

Materials and Instruments

The study utilized a survey questionnaire as the main research instrument to gather data on the level of artificial intelligence (AI) usage and the problem-solving behavior of Grade 11 students in mathematics at Bukidnon National School of Home Industries.

The instrument was divided into two parts. Part I focused on the level of AI usage in mathematics and was adapted from the framework developed by Capinding (2024). This section measured three indicators, namely reading, writing, and numeracy. Each indicator consisted of ten (10) statements designed to assess the extent of students' use of AI tools in mathematics-related tasks.

Rating	Range	Descriptive Rating	Qualitative Interpretation
5	4.50-5.00	Strongly Agree	Highly dependent
4	3.50-4.49	Agree	Dependent
3	2.50-3.49	Neutral	Moderately dependent
2	1.50-2.49	Disagree	Not dependent
1	1.00-1.49	Strongly Disagree	Highly not dependent

Part II measured the students' problem-solving behavior in mathematics. A 28-item problem-solving behavior questionnaire was adapted from Bayarcal and Tan (2023). It aimed to identify students' behaviors in terms of self-confidence, effort, and the procedures followed in solving mathematical problems.

A five-point Likert scale was utilized to determine and interpret the responses of the students in both parts of the questionnaire. The scale was used to measure the level of AI usage and problem-solving behavior of the respondents. The interpretation of data was based on the corresponding scale and verbal descriptions presented in the succeeding tables.

Scale	Range	Qualitative Description
5	4.51 – 5.00	Always
4	3.51 – 4.50	Often
3	2.51 – 3.50	Sometimes
2	1.51 – 2.50	Rarely
1	1.00 – 1.50	Never

Data Gathering Procedure

A formal letter of request was submitted by the researcher to the Office of the Schools Division Superintendent (SDS) of the Department of Education, Division of Bukidnon, seeking official approval to conduct the study among randomly selected Grade 11 students. Upon approval, the researcher coordinated with the school principal of Bukidnon National School of Home Industries by presenting the approved communication from the SDS, explaining the purpose and significance of the study, and discussing the procedures for data collection.

After securing permission from the school principal, arrangements were made with the class advisers to schedule the administration of the questionnaires at an appropriate and convenient time. The questionnaires were administered simultaneously to all selected sections to ensure uniformity in data collection.

Prior to the administration of the instruments, informed consent was secured from the respondents. Ethical considerations such as confidentiality, anonymity, and voluntary participation were strictly observed throughout the study.

A structured questionnaire was used to gather the required data, consisting of two parts: (1) the level of artificial intelligence (AI) usage among students, adapted from Capinding (2024) in terms of reading, writing, and numeracy; and (2) the problem-solving behavior of students, adapted from Bayarcal and Tan (2023).

The questionnaires were personally distributed to the respondents and retrieved immediately after completion, with a total allotted time of one (1) hour. After collection, the data were organized, tabulated, and subjected to appropriate statistical treatment to answer the research questions and test the hypotheses of the study.

RESULTS

Artificial Intelligence Usage of Grade 11 Students

The findings revealed that students were generally moderately dependent on artificial intelligence tools in mathematics-related tasks.

In terms of reading, students obtained an overall mean of 3.34, interpreted as Moderately Dependent. The highest-rated indicator was the use of AI-generated summaries to understand lengthy mathematical readings and problem explanations ($M = 3.73$), while the lowest-rated indicator involved the use of AI-generated audio explanations and text-to-speech tools ($M = 2.87$).

For writing, the overall mean was 3.25, also interpreted as Moderately Dependent. Students most frequently used AI tools to summarize and explain mathematical texts in simpler language ($M = 3.53$). Meanwhile, the least utilized AI feature involved AI-generated templates or outlines for structuring mathematical reports and write-ups ($M = 2.78$).

In terms of numeracy, students obtained an overall mean of 3.22, interpreted as Moderately Dependent. The highest mean was observed in students' openness to adopting new AI tools to improve mathematical problem-solving performance ($M = 3.50$), whereas the lowest mean involved reliance on AI algorithms to solve complex mathematical equations ($M = 2.92$).

Overall, the findings indicate that students moderately depend on AI tools across reading, writing, and numeracy, with reading obtaining the highest level of AI usage among the three dimensions.

Problem-Solving Behavior of Students

The results showed that students generally demonstrated high levels of problem-solving behavior in mathematics.

Among the dimensions, procedure followed obtained the highest overall mean of 4.38, interpreted as High, followed by self-confidence with a mean of 4.29, and putting effort with a mean of 4.27, both also interpreted as High.

The findings suggest that students generally demonstrate positive problem-solving behaviors, particularly in following systematic procedures, showing confidence in solving problems, and exerting effort in mathematical tasks.

Relationship Between Artificial Intelligence Usage and Problem-Solving Behavior

The Pearson Product-Moment Correlation analysis revealed a statistically significant relationship between artificial intelligence usage and problem-solving behavior ($r = -0.138$, $p = 0.036$).

The correlation coefficient indicates a very weak negative relationship between the variables, suggesting that increased AI usage is slightly associated with lower levels of independent problem-solving behavior among students.

Since the computed p-value was lower than the 0.05 level of significance, the null hypothesis stating that there is no significant relationship between artificial intelligence usage and problem-solving behavior was rejected.

DISCUSSION

The findings indicate that Grade 11 students are moderately dependent on artificial intelligence tools in reading, writing, and numeracy-related mathematical tasks. Students primarily use AI to simplify mathematical texts, improve written explanations, verify answers, and obtain guided assistance in solving problems. This suggests that AI functions as an academic support mechanism that helps learners manage the cognitive demands of mathematics learning.

The highest dependence was observed in reading-related AI functions, particularly AI-generated summaries and simplified explanations. This implies that students experience difficulty interpreting lengthy mathematical texts and therefore rely on AI to make content more accessible. Similarly, students use AI writing tools to improve clarity, grammar, and coherence in explaining mathematical solutions, while numeracy-related AI tools are commonly used for guided practice and answer verification rather than full automation of problem solving.

Despite the usefulness of AI tools, the study revealed a statistically significant negative relationship between artificial intelligence usage and problem-solving behavior. Although the relationship was very weak, the findings suggest that increased dependence on AI may slightly reduce students' independent reasoning, analytical thinking, and engagement in solving mathematical problems on their own.

The result supports the findings of Zheng et al., who explained that overreliance on AI tools may weaken students' metacognitive engagement during problem solving. Likewise, Hwang and Chen found that answer-focused AI use may reduce mathematical reasoning and critical thinking skills. In the Philippine context, Garcia and Reyes observed that students often use AI applications to complete tasks quickly without fully understanding the underlying procedures.

However, the findings do not suggest that AI is entirely harmful to learning. Instead, the results emphasize the importance of balanced and guided AI integration in mathematics education. When used responsibly and under proper teacher supervision, AI can serve as a valuable instructional aid that enhances comprehension, provides feedback, and supports student learning without replacing independent thinking and problem-solving processes.