

Artificial Intelligence Dependency in the 3R's and Mathematics Performance of Pre-Service Teachers

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Abstract: The increasing integration of artificial intelligence (AI) in education has raised questions about its impact on foundational academic skills, especially among future educators. This study aims to describe the relationship between AI dependency in the 3Rs (reading, writing, and arithmetic) and the mathematics performance of pre-service teachers at Bukidnon State University. It evaluated the extent to which students rely on AI-powered tools in reading comprehension, written communication, and numeracy tasks, while also assessing their academic performance in mathematics. The study used a correlational research design and involved 80 pre-service mathematics teachers selected through convenience sampling. Data were gathered using a validated 30-item questionnaire by Capinding (2024), which was divided into three domains and measured using a five-point Likert scale. The results showed that pre-service teachers had high levels of AI dependency, especially in writing tasks. Despite this, the majority performed very highly satisfactorily in mathematics. Pearson's correlation analysis revealed no significant relationship between AI dependency and mathematics performance in any of the three domains. The findings show that while AI tools are used, their impact on mathematics performance is not significant. It is recommended to balance the use of AI tools and the development of students' critical thinking skills.

Keywords - Intelligence, AI Dependency, 3Rs (reading, writing, and arithmetic), Mathematics Performance

I. INTRODUCTION

The integration of artificial intelligence (AI) into teaching and learning practices has become a key focus in the advancement of educational technology. Among the foundational academic skills, reading, writing, and arithmetic, commonly referred to as the 3Rs, are critical to student success. Reading involves the ability to comprehend, analyze, and interpret written texts, serving as the basis for knowledge acquisition (Duke & Carlisle, 2011). Writing refers to the capacity to express ideas clearly and coherently through structured text (Kellogg, 2008). Arithmetic, or numeracy, pertains to the ability to perform mathematical operations, solve quantitative problems, and apply logical reasoning in numerical contexts (Ginsburg et al., 2006). These three core skills are vital for the cognitive development required for lifelong learning (Millacci, 2022).

However, with the increasing integration of AI-powered tools, such as intelligent tutoring systems, automated essay scoring platforms, and mathematical problem-solving applications, concerns about students' dependency on AI have surfaced. One primary concern is the potential decline in cognitive engagement and independent learning. While AI can improve comprehension and automate complex tasks, excessive reliance on these technologies may hinder the development of critical thinking and problem-solving skills that are essential for effective teaching. According to Jia and Tu (2024), overreliance on AI in solving mathematical problems can reduce learners' self-efficacy and weaken their ability to develop independent strategies for learning. If AI tools were to become unavailable, pre-service teachers who depend heavily on them might struggle with basic academic tasks such as reading comprehension, constructing logical arguments, and solving math problems on their own.

This over-dependence could lead to a range of academic issues, including reduced analytical thinking, increased vulnerability to AI-generated errors, higher rates of plagiarism, and exposure to algorithmic biases (Zhai et al., 2024). Moreover, consistent reliance on AI for academic decision-making may diminish students' motivation to think independently and foster the development of automation bias (Gsenger & Strle, 2021). These challenges raise important concerns regarding the preparedness of pre-service teachers, who are expected to demonstrate independent thinking and critical analysis as future educators. Hence, maintaining a balance between AI integration and the cultivation of foundational cognitive skills is crucial.

Although research on AI in education has been expanding, there is a noticeable gap in the literature regarding the relationship between AI dependency in the 3Rs and mathematics performance among pre-service teachers.

Existing studies have predominantly highlighted the benefits of AI for high-achieving students, with limited empirical attention given to its potential negative effects on fundamental academic skills. Understanding this relationship is essential to addressing gaps in teacher education and ensuring that future educators possess the necessary mathematical competencies and cognitive skills.

This study aims to address this gap by investigating the AI dependency among pre-service teachers in the areas of reading, writing, and arithmetic and by analyzing its correlation with their academic performance in mathematics. By identifying which dimensions of AI reliance are most associated with their mathematics performance, this research seeks to inform teacher education programs in finding a healthy balance between embracing educational technology and reinforcing independent cognitive development. Ultimately, the goal is to prepare pre-service teachers who are not only technologically competent but also capable of critical and independent thinking. The participants of this study are pre-service mathematics teachers from Bukidnon State University. Data will be gathered using the questionnaire “Students’ AI Dependency in 3R’s: Questionnaire Construction and Validation” developed by Capinding (2024).

The intent of this study is to provide a quantitative understanding of how dependency on artificial intelligence in the 3Rs (reading, writing, and arithmetic) affects the academic performance of pre-service teachers in mathematics. Through this research, the authors aim to contribute valuable insights into the evolving role of AI in education and offer a foundation for developing informed intervention strategies. These strategies may guide teacher education programs in promoting balanced technology use while reinforcing the development of essential cognitive and analytical skills critical to future educators.

This study delves into the concept of Automation Bias Theory (Parasuraman & Manzey, 2010) that serves as the primary theoretical foundation for this study, explaining how individuals tend to over-rely on automated systems, often leading to uncritical acceptance of AI-generated outputs. This cognitive bias is particularly relevant in education, where pre-service teachers increasingly depend on AI-powered tools for reading, writing, and arithmetic (3Rs). As AI systems provide immediate answers and automated problem-solving, students may become less inclined to critically evaluate responses, verify solutions, or engage in independent analytical thinking skills that are essential for mathematics proficiency.

In the context of mathematics learning, automation bias can lead pre-service teachers to trust AI-generated solutions without questioning their accuracy or considering alternative solution strategies. This over-reliance may reduce their ability to develop problem-solving skills, mathematical reasoning, and independent cognitive engagement. Furthermore, as AI dependency increases, students may struggle with cognitive flexibility and fail to build confidence in their mathematical abilities, ultimately affecting their academic performance.

This study explores how automation bias influences pre-service teachers’ engagement with AI in the 3Rs and its predictive relationship with their mathematics performance. By understanding this dynamic, the research aims to highlight the potential risks of excessive AI reliance and provide insights into fostering a balanced approach that integrates AI while promoting independent critical thinking and mathematical competence.

The figure below depicts the relationship between the most significant variables. The first box represents the study’s independent variable, AI dependency in the 3Rs (reading, writing, and arithmetic), while the factors listed below include comprehension, coherence, and numerical reasoning. The second box contains the dependent variable, the students’ mathematics performance. The arrow represents the dynamic relationship between the independent variables and their impact on students’ mathematical performance, emphasizing the primary goal of this research: to understand how AI dependency interacts with cognitive processes and influences mathematical learning outcomes.

This study aimed to determine the significant relationship between artificial intelligence (AI) dependency in the 3Rs—reading, writing, and arithmetic—and the academic performance in mathematics of pre-service teachers. Specifically, it sought to assess the mathematics performance of pre-service teachers, determine their level of AI dependency in terms of reading, writing, and numeracy/arithmetic, and examine whether a significant relationship exists between AI dependency in the 3Rs and their academic performance in mathematics. The study further intended to explore how reliance on AI tools influences students’ proficiency in fundamental literacy and numeracy skills, particularly in analyzing, interpreting, and solving mathematical problems independently.

II. METHODOLOGY

Research Design

This study employs a quantitative research design, specifically utilizing a correlational approach to examine the relationship between AI dependency in the 3Rs (reading, writing, and arithmetic) and the academic performance of pre-service teachers in mathematics. A correlational design is appropriate for this study as it allows for the assessment of the strength and direction of relationships between variables without manipulating them.

Participants and Sampling

The participants of this study were pre-service mathematics teachers enrolled at the College of Education, Bukidnon State University, during the academic year 2024–2025. A total of eighty (80) pre-service teachers participated in the study. The researchers employed a convenience sampling technique, selecting participants based on their availability and willingness to respond, ensuring timely and efficient data collection.

Research Locale

The study will be conducted at the Casisang Annex campus of Bukidnon State University's College of Education, located in Purok 6, Malaybalay City, Bukidnon, a province in the Northern Mindanao region of the Philippines. The Casisang Annex serves as a hub for the College of Education, housing various academic programs and facilities. BukSU is renowned for its commitment to quality education, particularly in teacher training. The College of Education offers accredited programs, including the Bachelor of Elementary Education (BEEd) and Bachelor of Secondary Education (BSEd), which have achieved Level III accreditation status. Additionally, the university has been recognized as a Center of Development for Teacher Education, highlighting its excellence in this field (Bukidnon State University, 2016).

Research Instruments

The research instrument encompasses three essential components: informed consent, the demographic profile of the pre-service teachers in mathematics, including their name, year level, and general point average (GPA) of their Elementary Statistics and Probability course, and a survey questionnaire designed to assess AI dependency in reading, writing, and arithmetic and its potential effects on pre-service teachers' mathematics performance. This instrument was adapted from Capinding (2024) and consists of three main domains: reading, writing, and numeracy/arithmetic. The questionnaire aims to measure the extent to which participants rely on AI-powered tools for these academic skills.

The research questionnaire adapted includes a set of thirty statements, with 10 items per domain. In the reading domain, participants respond to items related to their use of AI-generated summaries, translation tools, news aggregators, and content curation platforms. The writing domain assesses AI-assisted spelling and grammar checks, content generation, paraphrasing, proofreading, and creative writing support. Meanwhile, the numeracy/arithmetic domain focuses on AI-powered calculators, problem-solving applications, automated mathematical analyses, and AI-assisted tutoring systems. A five-point Likert scale is used to express the participants' responses to each question. There are five possible responses: strongly disagree, disagree, neutral, agree, and strongly agree. A weighted score of 1, 2, 3, 4, and 5 was assigned to the statements' responses. Here's how each domain is rated:

Responses	Scale	Range	Qualitative Interpretation
Strongly Disagree	1	1.00-1.80	Extremely low
Disagree	2	1.81-2.60	Low
Neutral	3	2.61-3.40	Moderate
Agree	4	3.41-4.20	High
Strongly Agree	5	4.21-5.00	Extremely High

The researchers selected pre-service mathematics teachers who had taken the course Elementary Statistics and Probability. This course served as the basis for assessing their academic performance in mathematics. To determine the mathematics performance of the pre-service teachers, the researchers adopted the grading scale provided by Dokor (2024), which reflects the updated grading system used by universities in the Philippines.

Grade	Range	Interpretation
1.00	1.00 – 1.24	Excellent
1.25	1.25 – 1.49	Outstanding
1.50	1.50 – 1.74	Very Highly Satisfactory

1.75	1.75 – 1.99	Highly Satisfactory
2.00	2.00 – 2.24	Satisfactory
2.25	2.25 - 2.49	Moderately Satisfactory
2.50	2.50 – 2.74	Less Satisfactory
2.75	2.75 – 2.99	Better than passing
3.00	3.00 – 3.00	Passing
5.00	5.00 – 5.00	Failing

Data Gathering Procedure

The researcher sought permission from the participants before conducting the study, which involved obtaining approval from the authorities, including the Dean of the College of Education. The permission letter included details on informed consent, data confidentiality as defined by the Data Privacy Act of 2012, and the researcher's role and responsibilities. Upon approval, a letter of intent was issued to the respondents, advising them of the study's purpose. The survey questionnaire was then distributed in person, along with a consent form.

Treatment of Data

Different statistical tools were employed to present, interpret, and analyze collected data. The responses gathered through the "Students' AI Dependency in 3R's: Questionnaire Construction and Validation" were analyzed using descriptive statistics to summarize and describe the main features of the data. Specifically, the mean, median, mode, and standard deviation were computed for each Likert scale item across the three domains: reading, writing, and numeracy/arithmetic. These measures provided an overview of the pre-service mathematics teachers' level of AI dependency in each domain. Pearson's correlation was employed to determine the significant relationship between AI dependency in the 3Rs and the mathematics performance of pre-service teachers.

III.RESULTS AND DISCUSSION

This chapter presents the summary of the study, findings, conclusions, and recommendations made based on the results of the study.

Table 1. Mean and Frequency Distribution of the Academic Performance of Pre-service Teachers

Range	Grade	F	%	Interpretation
1.00 – 1.24	1.00	3	3.75	Excellent
1.25 – 1.49	1.25	14	17.5	Outstanding
1.50 – 1.74	1.50	26	32.5	Very Highly Satisfactory
1.75 – 1.99	1.75	18	22.5	Highly Satisfactory
2.00 – 2.24	2.00	9	11.25	Satisfactory
2.25 - 2.49	2.25	7	8.75	Moderately Satisfactory
2.50 – 2.74	2.50	3	3.75	Less Satisfactory
2.75 – 2.99	2.75	0	0	Better than passing
3.00 – 3.00	3.00	0	0	Passing
5.00 – 5.00	5.00	0	0	Failing
Mean = 1.66		Total = 80	Very Highly Satisfactory	

Table 1 presents the mathematics performance of 80 pre-service teachers. The data shows that 32.5% of the respondents achieved a grade of 1.50, placing them in the "Very Highly Satisfactory" category. 17.5% received a grade of 1.25 ("Outstanding"), while 22.5% received a grade of 1.75 ("Highly Satisfactory"). The computed mean grade is 1.66, which falls under the "Very Highly Satisfactory" interpretation, indicating strong overall performance among the participants.

According to the study by Wijaya et al. (2024), students who understand how to use AI tools wisely and who think carefully about the information they get tend to learn better and manage their learning more effectively. However, only a small number of students (3.75%) reached the highest grade of 1.00 or "Excellent." This is because even though AI can help organize learning, it does not always encourage deep thinking or full understanding, especially in complex subjects like math. Wu and Yu (2023) explained that AI chatbots can assist with learning but don't naturally help students think more deeply, which explain why only a few students earned top marks. On the other hand, there were also students who performed less well, falling into the "Satisfactory" or "Moderately Satisfactory" groups. This might be due to too much reliance on AI-generated answers without doing their own thinking. Ahmad et al. (2023) found that students who depend too much on AI can struggle with thinking critically and managing their learning on their own.

Table 2.1 Mean and Standard Deviation of AI Dependency in Reading

AI Dependency in Reading	Mean	SD	Interpretation
1. I use AI-generated summaries to understand lengthy articles or documents.	3.975	0.927	High
2. I depend on AI-driven recommendations to discover new books, articles, or other reading materials.	3.663	0.954	High
3. I rely on AI-enhanced tools for extracting key information from research papers or academic articles.	3.750	0.961	High
4. AI-driven language comprehension tools assist me in understanding complex texts.	4.000	0.856	High
5. I use AI-powered educational platforms for personalized learning experiences.	3.850	0.7810	High
6. AI-driven accessibility tools help me consume written content more comfortably (e.g., screen readers).	3.725	0.968	High
7. AI-generated transcripts or subtitles assist me when watching videos or listening to podcasts.	3.650	1.104	High
8. I use AI-driven language learning apps to improve my reading skills in different languages.	3.713	1.034	High
9. AI-driven search engine suggestions help me find relevant reading materials more efficiently.	3.850	0.943	High
10. I depend on AI-generated book reviews or ratings when deciding what to read.	3.425	0.952	High
OVERALL	3.760	0.959	High

Note: N=80

Legend:

Responses	Scale	Qualitative Interpretation
Strongly Agree	4.21 - 5.00	Very High
Agree	3.41 – 4.20	High
Neutral	2.61 – 3.40	Moderate
Disagree	1.81 – 2.60	Low
Strongly Disagree	1.00 – 1.80	Very Low

Table 2.1 presents the mean and standard deviation of AI Dependency in Reading among pre-service mathematics teachers. Among the ten items, the top three with the highest mean scores were: "AI-driven language comprehension tools assist me in understanding complex texts" with a mean of 4.000, followed by "I use AI-generated summaries to understand lengthy articles or documents" with a mean of 3.975, and "I use AI-powered educational platforms for personalized learning experiences" with a mean of 3.850. This indicates that students heavily depend on AI to simplify complex materials and support personalized reading experiences.

Meanwhile, the items with the lowest mean scores were: "I depend on AI-generated book reviews or ratings when deciding what to read" with a mean of 3.425, "AI-generated transcripts or subtitles assist me when watching videos or listening to podcasts" with a mean of 3.650, and "I depend on AI-driven recommendations to discover new books, articles, or other reading materials" with a mean of 3.663. These results show that students were less reliant on AI for supplementary reading supports.

The overall mean rating of 3.760 suggests a high AI dependency in reading. These findings support the study by Ahmad et al. (2023), which highlights that AI-powered tools significantly aid comprehension and learning

efficiency. Similarly, Wijaya et al. (2024) noted that AI usage in structured reading tasks can help students manage information overload. However, it is important to note that Wu and Yu (2023) caution that heavy reliance on AI-generated summaries and comprehension tools may hinder deep cognitive engagement and independent interpretation skills. These findings emphasize the need to balance AI-assisted learning with critical and independent reading practices. Sperling et al. (2024) further highlighted the importance of teaching students to evaluate AI-generated content critically rather than accepting it at face value. In this context, pre-service mathematics teachers should be encouraged to integrate AI support with independent thinking to strengthen their reasoning abilities.

Table 2.2 Mean and Standard Deviation of AI dependency in Writing

AI Dependency in Reading	Mean	SD	Interpretation
1. I utilize AI-based spelling and grammar checkers when composing written content.	4.100	0.821	High
2. I rely on AI tools for generating ideas or suggestions when drafting written documents.	3.838	0.787	High
3. I use AI-driven writing assistants to enhance the overall quality of my written work.	3.988	0.738	High
4. AI-driven content creation tools help me generate creative or promotional written materials.	3.813	0.731	High
5. I rely on AI-enhanced proofreading tools to identify errors in my written work.	3.963	0.754	High
6. AI-generated suggestions for email subject lines improve the effectiveness of my written communication.	3.825	0.854	High
7. I depend on AI-based content summarization tools for condensing lengthy written materials.	3.913	0.829	High
8. I use AI-driven brainstorming tools to generate ideas for written projects.	4.000	0.779	High
9. AI-powered writing prompts or exercises help me overcome writer's block.	3.875	0.700	High
10. I rely on AI-generated suggestions for enhancing the clarity and coherence of my written content.	4.037	0.754	High
OVERALL	3.935	0.777	High

Note: N=80

Legend:

Responses	Scale	Qualitative Interpretation
Strongly Agree	4.21 - 5.00	Very High
Agree	3.41 - 4.20	High
Neutral	2.61 - 3.40	Moderate
Disagree	1.81 - 2.60	Low
Strongly Disagree	1.00 - 1.80	Very Low

Table 2.2 presents the mean and standard deviation of AI dependency in writing among pre-service mathematics teachers. Among the ten items, the top three with the highest mean scores were "I utilize AI-based spelling and grammar checkers when composing written content" with a mean of 4.100, followed by "I rely on AI-generated suggestions for enhancing the clarity and coherence of my written content" with a mean of 4.037, and "I use AI-driven brainstorming tools to generate ideas for written projects" with a mean of 4.000. These results indicate that students often use AI tools to refine the technical and structural quality of their writing.

On the other hand, the three items with the lowest mean scores were "I rely on AI tools for generating ideas or suggestions when drafting written documents" with a mean of 3.838, "AI-driven content creation tools help me generate creative or promotional written materials" with a mean of 3.813, and "AI-generated suggestions for email subject lines improve the effectiveness of my written communication" with a mean of 3.825. This suggests that while students trust AI in technical aspects, they are slightly less dependent on AI for creative and content development tasks.

The overall mean score of 3.935 reflects a high AI dependency in writing. These findings are supported by the researchers Zhao et al. (2025) and Bouzar et al. (2024), who have found that students often use tools like Grammarly and ChatGPT to improve how their writing looks and sounds. However, these same studies also point out that becoming too reliant on AI might hold students back from developing important skills like critical thinking and editing their own work. The fact that students lean more on AI for grammar and structure than for content creation connects with the ideas of Kim and Graham (2022). They stress how important it is for students, especially future teachers, to build their own knowledge of language and writing structures. While AI can offer helpful support, it shouldn't take over the learning process.

These findings suggest that pre-service mathematics teachers are making good use of AI tools to polish their writing. But at the same time, it's important for teacher education programs to help students find a healthy balance in using AI as a support so they continue to grow in both writing and critical thinking on their own.

Table 2.3 Mean and Standard Deviation of AI dependency in Arithmetic

AI Dependency in Reading	Mean	SD	Interpretation
1. I employ AI-powered calculators or apps for basic arithmetic calculations.	3.313	1.038	Moderate
2. I rely on AI algorithms to solve complex mathematical problems beyond basic arithmetic.	3.625	1.036	High
3. I use AI-based tools to check my calculations for accuracy.	3.775	0.967	High
4. I depend on AI-driven educational platforms for learning and practicing mathematical concepts.	3.587	1.122	High
5. I incorporate AI-based tutoring systems to enhance my spatial.	3.737	0.964	High
6. I rely on AI-assisted methods for generating mathematical models and equations.	3.650	0.915	High
7. I depend on AI algorithms to automate repetitive tasks involving various numeracy skills in my work or studies.	3.450	0.979	High
8. I am open to adopting new AI tools and technologies for improving my numeracy skills.	4.163	0.702	High
9. I prefer AI-generated explanations and step-by-step solutions for learning new mathematical concepts.	3.788	0.937	High
10. I trust AI systems to assist in decision-making processes involving numeracy tasks.	3.625	0.877	High
OVERALL	3.671	0.978	High

Note: N=80

Legend:

Responses	Scale	Qualitative Interpretation
Strongly Agree	4.21 - 5.00	Very High
Agree	3.41 – 4.20	High

Neutral	2.61 – 3.40	Moderate
Disagree	1.81 – 2.60	Low
Strongly Disagree	1.00 – 1.80	Very Low

Table 2.3 presents the mean and standard deviation of AI dependency in arithmetic among respondents. Among the ten items, the top three with the highest mean scores were "I am open to adopting new AI tools and technologies for improving my numeracy skills" with a mean of 4.163, followed by "I prefer AI-generated explanations and step-by-step solutions for learning new mathematical concepts" with a mean of 3.788, and "I use AI-based tools to check my calculations for accuracy" with a mean of 3.775. These results indicate that respondents highly value AI for its potential to improve numeracy skills, facilitate learning, and enhance the accuracy of their calculations. This reflects a strong interest in leveraging AI for more advanced or concept-driven mathematical tasks.

On the other hand, the three items with the lowest mean scores were "I employ AI-powered calculators or apps for basic arithmetic calculations" with a mean of 3.313, "I depend on AI algorithms to automate repetitive tasks involving various numeracy skills in my work or studies" with a mean of 3.450, and "I depend on AI-driven educational platforms for learning and practicing mathematical concepts" with a mean of 3.587. These findings suggest that respondents are slightly less inclined to use AI for basic or repetitive tasks, potentially reflecting a preference for traditional methods in these areas.

The overall mean score of 3.671 reflects a high AI dependency in arithmetic. These findings align with the study by Opesemowo (2025), which emphasized the effectiveness of AI in personalizing learning and offering instant feedback, particularly through adaptive learning systems. Similarly, the study by Hwang (2022) found that AI tools like Intelligent Tutoring Systems (ITS) significantly improved students' mathematical performance by providing personalized support and fostering engagement. Furthermore, Mohamed et al. (2022) highlighted AI's ability to track progress and provide targeted interventions, which supports the observed reliance on AI for accuracy and skill enhancement in the data. However, Opesemowo (2025) cautioned against over-reliance on AI, noting that it may limit critical thinking development, a concern that could explain the relatively lower mean scores for basic arithmetic tasks.

These findings suggest that respondents use AI tools to enhance their learning, particularly for advanced problem-solving and skill-building. At the same time, it is essential for educational programs to encourage a balanced approach that combines AI use with opportunities to develop independent problem-solving and critical thinking skills. This ensures that learners gain both the benefits of AI support and the ability to sustain their growth without over-dependence on technology.

Table 3. Correlation between Academic Performance and AI Dependency in 3R's

	Correlation Coefficient	p-value
Academic Performance and AI Dependency in 3Rs	-0.088	0.437

Table 3 presents the correlation between AI dependency in the 3Rs (reading, writing, and arithmetic) and the academic performance in mathematics among pre-service teachers. The computed Pearson correlation coefficient was $r = -0.088$ with a corresponding p-value of 0.437. The negative correlation, although weak, suggests that as AI dependency slightly increases, mathematics performance tends to slightly decrease. However, because the p-value exceeds the 0.05 level of significance, the correlation is not statistically significant. Thus, the null hypothesis, which states that there is no significant relationship between AI dependency in the 3Rs and mathematics performance, is accepted, and the alternative hypothesis is rejected.

The findings are supported by studies of Hwang (2022), which conducted a meta-analysis showing that AI-powered adaptive learning systems can significantly improve students' basic arithmetic skills by offering personalized practice tailored to individual skill levels. This personalization can help close learning gaps and ensure equitable learning opportunities in classrooms. Additionally, Mohamed et al. (2022) noted that AI systems, by tracking progress and identifying areas where students struggle, enable teachers to provide targeted support. These systems allow students to engage actively with the material, fostering improved problem-solving skills and enhancing their mathematics performance.

The results suggest that AI tools, when over-relied on, may not significantly affect mathematics performance, particularly if they are used passively or in a way that discourages independent learning. However, they can still serve as useful aids when integrated thoughtfully into educational practices. This highlights the importance of fostering balanced use of AI tools, ensuring they complement rather than replace critical thinking and problem-solving.

IV. SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

This chapter presents the summary, findings, conclusions, and recommendations of the study based on the data gathered and analyzed. The study was conducted at Bukidnon State University Casisang Annex during the Academic Year 2024–2025 and aimed to determine the relationship between Artificial Intelligence (AI) in the 3Rs—Reading, Writing, and Numeracy/Arithmetic—and the mathematics performance of pre-service teachers. A total of eighty (80) pre-service mathematics teachers participated in the study. The research utilized a quantitative correlational design and employed a survey questionnaire adapted from Capinding (2024) to measure AI dependency in reading, writing, and arithmetic. Descriptive statistics revealed that most of the respondents achieved a “Very Highly Satisfactory” level of mathematics performance, with an overall mean grade of 1.66. The results also showed a high level of AI dependency across the three domains, with the highest reliance observed in writing activities. Pearson’s correlation analysis was used to determine the relationship between AI dependency and mathematics performance.

The findings of the study revealed that the majority of the pre-service teachers demonstrated strong proficiency in mathematics, as evidenced by their mean grade of 1.66, and none of the participants fell under the “Moderately Satisfactory” category. Furthermore, the study indicated that pre-service mathematics teachers heavily relied on AI tools, particularly in writing activities, followed by reading and arithmetic. The respondents frequently utilized grammar checkers, summarization tools, AI-powered calculators, and other academic support applications to enhance their learning performance. However, statistical analysis showed that there was no significant relationship between AI dependency in reading, writing, and arithmetic and mathematics performance. This suggests that although students exhibited high levels of AI usage, such dependency did not significantly influence or predict their academic performance in mathematics.

Based on the findings, the study concluded that pre-service teachers remained proficient in mathematics despite their high level of AI dependency. The results further confirmed that AI dependency existed across all three domains of the 3Rs. In reading, pre-service teachers frequently relied on AI tools to better comprehend complex texts and obtain summarized information. In writing, students extensively utilized AI-driven applications for grammar correction, coherence improvement, and idea generation in their written outputs. In arithmetic, students demonstrated high dependence on AI-powered calculators, tutoring platforms, and step-by-step problem-solving tools. Despite the extensive use of AI technologies, no significant relationship was found between AI dependency and mathematics performance, indicating that AI usage did not strongly affect the academic outcomes of the respondents in mathematics.

In light of these findings and conclusions, several recommendations were proposed. Future studies should explore other possible factors influencing mathematics performance, including cognitive abilities, learning strategies, instructional quality, and student motivation. Educational programs should also promote balanced learning approaches that integrate AI-assisted learning while strengthening independent cognitive and analytical skills to prevent excessive reliance on technology. Teacher education institutions are encouraged to enhance students’ critical AI literacy by teaching them to use AI responsibly as a supportive educational tool while maintaining independent problem-solving and critical thinking skills. Instructors should likewise provide structured interventions that encourage deeper engagement with learning materials, foster self-directed learning, and reduce passive acceptance of AI-generated content. Finally, regular monitoring and reflective assessments should be implemented to help students evaluate their AI usage and develop healthier academic practices that balance technological support with independent thinking.

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