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PERCEIVED USEFULNESS OF ARTIFICIAL INTELLIGENCE AND STUDENT ENGAGEMENT ON ACADEMIC PERFORMANCE IN TRIGONOMETRY AMONG BSED MATH STUDENTS

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ABSTRACT

This study examined the perceived usefulness of Artificial Intelligence (AI) and student engagement in relation to academic performance in Trigonometry among Bachelor of Secondary Education (BSED) Mathematics students at Don Carlos Polytechnic College. Specifically, it sought to determine the level of perceived usefulness of AI in terms of ease of use, effectiveness in learning core topics, and improvement of problem-solving skills. It also aims to assess student engagement in affective, behavioral, and cognitive dimensions, evaluate academic performance, and identify significant relationships among these variables. Employing a descriptive-correlational research design, the researchers administered a validated structured questionnaire to 37 second year BSED Mathematics students. Data were analyzed using mean, standard deviation, and Pearson Product-Moment Correlation. Findings revealed a high level of perceived usefulness of AI, with ease of use rated highest, followed by learning effectiveness and problem-solving enhancement. Student engagement was likewise high, particularly in affective engagement, indicating strong interest, enjoyment, and motivation in learning Trigonometry. Academic performance was generally satisfactory, reflecting acceptable mastery of concepts. However, correlation analysis showed no significant relationship between perceived usefulness of AI and academic performance, nor between student engagement and academic performance. Thus, the hypothesis stating significant relationships was rejected. This suggests that although students perceive AI tools positively and demonstrate high engagement, these factors do not necessarily translate into significantly higher academic performance in Trigonometry. Further studies are recommended to explore additional factors influencing academic performance in technology-assisted learning environments among undergraduate mathematics students in future.

Keyword: Academic Performance, Perceived Usefulness of AI, Learning Engagement

1. INTRODUCTION

Academic performance in trigonometry is the central focus of this study, as it reflects students' mastery of essential mathematical competencies. Trigonometry involves key concepts such as identities, inverse functions, graphical analysis of sine and cosine functions, and applications in periodic phenomena. These concepts require higher-order thinking skills, including reasoning, visualization, and problem-solving, which are essential for success in mathematics and related disciplines (Büchele & Feudel, 2023). However, due to its abstract and cognitively demanding nature, students often encounter difficulties in understanding and applying trigonometric concepts (Peng et al., 2016). Given its relevance in fields such as engineering, science, and technology, developing strong proficiency in trigonometry remains critical for students' academic progression.

Despite its importance, academic performance in trigonometry continues to be a concern across educational contexts. Studies indicate that students' difficulties in mathematics are often associated with limited conceptual understanding, low motivation, and insufficient engagement in learning tasks (Peng & Lin, 2019). In the Philippine setting, the Department of Education (DepEd, 2022) reports persistent gaps in mathematics achievement, emphasizing the need

for more effective instructional approaches. These challenges are also evident in higher education, were students, including pre service mathematics teachers, struggle with abstract topics such as trigonometry. While various strategies have been implemented, there remains a lack of research focusing on how emerging technologies and learner-related factors jointly influence academic performance in this area.

One emerging factor influencing academic performance is the perceived usefulness of Artificial Intelligence (AI) in education. AI systems are designed to support learning through features such as adaptive feedback, personalized instruction, and intelligent tutoring (Chen et al., 2020). Research shows that AI 2 integration in mathematics education can significantly enhance learning outcomes by improving students' understanding of complex concepts and providing immediate feedback (Zhang et al., 2025).

More importantly, students' perception of AI plays a critical role in its effectiveness. When learners perceive AI tools as useful, they are more likely to adopt them and engage actively in learning tasks (Al-Adwan et al., 2023). This positive perception has been linked to increased motivation and improved academic performance (Avanceña et al., 2025). Furthermore, recent studies highlight that generative AI tools can support deeper conceptual understanding by facilitating problem-solving and providing scaffolded explanations, particularly in mathematically intensive subjects such as trigonometry (Kasneci et al., 2023).

Student engagement is another key factor that significantly influences academic performance. It refers to the degree of students' active involvement in learning, encompassing behavioral, emotional, and cognitive dimensions (Bond et al., 2020). High levels of engagement are consistently associated with better academic outcomes, as engaged students demonstrate persistence, focus, and effective learning strategies (Lei et al., 2018).

In mathematics education, engagement is especially important due to the need for sustained attention and logical reasoning. Studies show that students who are actively engaged are more likely to develop deeper understanding and achieve higher performance levels (Henrie et al., 2018). Additionally, technology-enhanced environments, including AI-supported platforms, can further promote engagement by making learning more interactive and adaptive (Kong et al., 2021). Evidence also suggests that AI assisted learning can strengthen cognitive engagement and self-regulated learning, ultimately improving academic outcomes (Thomas et al., 2023).

This study assumes that the perceived usefulness of AI and student engagement are significantly related to academic performance in trigonometry. It aims to examine how these variables influence students' learning outcomes by determining whether students who perceive AI as useful demonstrate higher levels of engagement and improved academic performance. Through this, the 3 study seeks to identify key factors that contribute to students' success in trigonometry.

This study investigated the relationship among the perceived usefulness of AI, student engagement, and academic performance in Trigonometry among BSEd Mathematics students. It hypothesized that students who perceive AI tools as beneficial are more likely to engage actively in learning, leading to improved understanding and academic performance. AI technologies offer opportunities for interactive, adaptive, and personalized learning experiences, which can enhance both student engagement and academic achievement (Zhang et al., 2025).

Given the increasing use of AI in education and the continuing challenges in Mathematics learning, this study tested whether the perceived usefulness of AI and student engagement significantly predict academic performance in Trigonometry. The findings aimed to support the development of effective, technology-integrated, and engagement-focused instructional strategies that could improve Mathematics education and better prepare future educators.

1.1 Statement of the Problem

This study aimed to determine the relationship between the perceived usefulness of artificial intelligence and student engagement on academic performance in Trigonometry among BSED Math students.

Specifically, it sought to answer the following questions:

1. What is the level of usefulness of AI tools for trigonometry as perceived by BSED Math students in terms of: a. ease of use for solving trigonometry

problems, b. usefulness for learning and mastering core trigonometry topics, and c. improvement of problem-solving skills in trigonometry?

2. What is the level of student engagement in trigonometry among BSED Math students in terms of:

a. affective engagement,

b. behavioral engagement, and

c. cognitive engagement?

3. What is the level of academic performance in trigonometry among BSED Math students?

4. Is there a significant relationship on perceived usefulness of AI to students' academic performance in trigonometry?

5. Is there a significant relationship on students' engagement to students' academic performance in trigonometry?

1.2 Hypothesis of the Study

Based on the research question, the following hypothesis were stated as guide the study:

Ha_1 : There is a significant relationship on perceived usefulness of AI to students' academic performance.

Ha_2 : There is a significant relationship on students' engagement to students' academic performance in trigonometry.

2. METHODOLOGY

This chapter presented the research design, locale of the study, the respondents of the study, research instruments, data gathering technique, ethical considerations, and the statistical analysis of the study.

2.1 Research Design

This study employed a descriptive-correlational research design to investigate the relationships among the perceived usefulness of Artificial Intelligence (AI), student engagement, and academic performance in Trigonometry among BSEd Mathematics students at Don Carlos Polytechnic College. This design was suitable for addressing the research questions and objectives, as it enabled a systematic examination of existing conditions and the associations among variables without manipulating them (Creswell & Creswell, 2018). In educational research, descriptive-correlational design is particularly useful for understanding how variables interact in real-world settings, especially when experimental control is impractical or unethical (Polit & Beck, 2017). The descriptive component of the design was utilized to provide a detailed account of the levels of perceived usefulness of AI, student engagement, and academic performance among the target population.

2.2 Locale of the Study

The study was conducted at Don Carlos Polytechnic College (DCPC) among BSED Math students, located in P – 2 Poblacion Norte, Don Carlos, in the province of Bukidnon, Philippines. The institution is operated and funded by the Local Government Unit (LGU) of Don Carlos and serves as the primary higher education institution in the municipality.

Don Carlos Polytechnic College (DCPC) is a community – based public college established to provide accessible and affordable tertiary education to students within Don Carlos and nearby municipalities. As an LGU–run institution, DCPC aims to develop competent professionals and future educators who will contribute to local and national development.

2.3 Sampling Procedure

This study utilized total enumeration sampling, wherein all members of the population who met the established criteria were included as participants. This sampling technique was considered appropriate because the target population was manageable in size, allowing the researchers to collect comprehensive and representative data from all qualified participants.

2.4 Research Instrument

The study utilized a survey questionnaire adapted from Ekunke, Unyime Abasi Raphael (2023) and Etcuban, J.O. (2025) as the main research instrument. It was designed to collect information on the three major variables of the study: perceived usefulness of AI, student engagement, and academic performance among BSEd Mathematics students of Don Carlos Polytechnic College. The questionnaire was divided into three main parts.

Part I of the questionnaire focused on the students' perceived usefulness of AI. This section

consisted of three indicators: (a) ease of use, adapted from Ekunke and Unyime-Abasi Raphael (2023); (b) usefulness for learning and mastering core algebra topics; and (c) improvement of problem-solving skills in Algebra, both adapted from Etcuban, J.O. (2025). Each indicator contained fifteen (15) statements designed to assess the respondents' perceptions regarding the use of AI in learning Mathematics.

Part II of the questionnaire measured student engagement and was adapted from Fredricks et al. (2004). This section included three indicators: affective engagement, behavioral engagement, and cognitive engagement. Each indicator consisted of twelve (12) questions, except for affective engagement, which contained only ten (10) questions.

Part III of the questionnaire focused on academic performance, which was measured by collecting the students' grades through coordination with their respective instructors.

2.5 Scoring Procedure

This study employed a 5-point Likert scale to measure the respondents' level of perceived usefulness of AI and student engagement.

In determining the level of perceived usefulness of AI among BSEd Mathematics

For the academic performance, the following scoring procedure was used:

Rating	Range	Descriptive Rating	Qualitative Interpretationn
5	4.50-5.00	Strongly Agree	Very High
4	3.50 – 4.49	Agree	High
3	2.50 – 3.49	Neutral	Moderate
2	1.50 – 2.49	Disagree	Law
1	1.00 – 1.49	Strongly Disagree	Very Law

In determining the level of Student's Engagement of AI in BSEd Math students, the following scale was used:

Rating	Range	Descriptive Rating	Qualitative Interpretation
5	4.50-5.00	Strongly Agree	Very High
4	3.50 – 4.49	Agree	High
3	2.50 – 3.49	Neutral	Moderate
2	1.50 – 2.49	Disagree	Law
1	1.00 – 1.49	Strongly Disagree	Very Law

In evaluating the students' level of academic performance in trigonometry, Don Carlos Polytechnic College grading system was used. The grade is according to the 1.00 to 5.00 scale range, with 1.00 as the highest grade, 3.00 as the passing grade and 5.00 a failed grade as shown below:

Grade	Percentage Equivalent	Description
1.00	98–100%	Excellent
1.25	95–97%	Very Good
1.50	92–94%	Very Good
1.75	88–91%	Good
2.00	85–87%	Good
1.25	82–84%	Average
1.50	80–81%	Fair
2.75	76–79%	Poor
3.00	75%	Passing
5.00	74% and below	Failed

2.6 Ethical Considerations

This study strictly adhered to established ethical principles in conducting research involving human participants. The principles of respect for persons, beneficence, and justice as stated in the Belmont Report guided the conduct of the research. Prior to data collection, permission was secured from the appropriate school authorities.

The participants were informed about the purpose, procedures, and objectives of the study, and informed consent was secured prior to data collection. Participation in the study was entirely voluntary, and respondents were given the right to withdraw at any time without penalty. Although the participants' names were required in the questionnaire for academic record purposes, confidentiality and anonymity were strictly observed. All information gathered was treated with utmost confidentiality and used solely for academic purposes.

2.7 Statistical Treatment

This study used descriptive statistics such as mean, standard deviation, frequency, and percentage to determine the levels of perceived usefulness of AI, student engagement, and academic performance. Pearson Product- Moment Correlation was employed to examine the

relationship between perceived usefulness of AI and academic performance, as well as between student engagement and academic performance.

3. RESULTS AND DISCUSSIONS

3.1 The Level of Perceived Usefulness of AI Tools for Trigonometry as Perceived by BSED Math Students in terms of Ease of Use

Table 1 presents the level of perceived usefulness of AI tools for Trigonometry as perceived by BSED Mathematics students in terms of ease of use. The overall weighted mean is 3.84, interpreted as "Agree" with a qualitative interpretation of "High." The three highest mean scores were obtained by the statements: "My interaction with the Artificial Intelligence (AI) is easy for me to understand" (M = 4.03), "Artificial intelligence supports critical aspects of my learning process" (M = 3.95), and both "I find it easy to apply the Artificial Intelligence (AI) in doing Trigonometry assignment" and "Using Artificial Intelligence (AI) is easy and understandable" (M = 3.92). On the other hand, the three lowest mean scores were "Using Artificial Intelligence (AI) gives me greater control in my learning process" (M = 3.65), "It is easy to become skillful at using Artificial Intelligence (AI)" (M = 3.68), and "I find Artificial Intelligence (AI) easy to use when sourcing for diagram in Trigonometry" (M = 3.70). Despite having the lowest means, all indicators were still interpreted as "Agree" and "High."

Table 1 Perceived usefulness of AI tools for Trigonometry as perceived by BSED Math students in terms of ease of use.

Statements	Mean	Descriptive Rating	Qualitative Interpretation
My interaction with the Artificial Intelligence (AI) is easy for me to understand.	4.03	Agree	High
Artificial intelligence supports critical aspects of my learning process.	3.95	Agree	High
I find it easy to apply the Artificial Intelligence (AI) in doing Trigonometry assignment.	3.92	Agree	High
Using Artificial Intelligence (AI) is easy and understandable.	3.92	Agree	High
My interaction with the Artificial Intelligence (AI) is easy for me to understand.	3.92	Agree	High
Interacting with the Artificial Intelligence (AI) during learning of Trigonometry improve my knowledge.	3.86	Agree	High
I find it easy to recover from errors encountered while using Artificial Intelligence (AI) during learning process.	3.76	Agree	High
I find Artificial Intelligence (AI) easy to use when sourcing for diagram in Trigonometry.	3.70	Agree	High
It is easy to become skillful at using Artificial Intelligence (AI).	3.68	Agree	High
Using Artificial Intelligence (AI) gives me greater control in my learning process.	3.65	Agree	High
Weighted Mean	3.84	Agree	High

Rating	*Range*	*Descriptive Rating*	*Qualitative Interpretation*
5	*4.50 – 5.00*	*Strongly Agree*	*Very High*
4	*3.50 – 4.49*	*Agree*	*High*
3	*2.50 – 3.49*	*Neutral*	*Moderate*
2	*1.50 – 2.49*	*Disagree*	*Low*
1	*1.00 – 1.49*	*Strongly Disagree*	*Very Low*

The findings imply that the data indicate that students generally perceive AI tools as accessible, understandable, and manageable in learning Trigonometry. The highest-rated indicators suggest that students can easily interact with AI systems and apply them in completing academic tasks, which reflects positive usability experiences. The findings also show that AI is viewed as supportive in important learning processes such as understanding lessons and accomplishing assignments. Meanwhile, the lowest-rated indicators reveal that students are comparatively less certain about AI's role in giving them greater control over their learning process and in helping them become fully skillful users. Although these indicators still received high interpretations, they imply that students may still be adjusting to maximizing AI tools independently.

The result shows that AI tools are generally accepted by students because they are easy to use and convenient for learning Trigonometry. The consistently high ratings demonstrate that students do not encounter major difficulties when interacting with AI applications, which may encourage continuous usage in academic activities. Since Trigonometry involves abstract concepts and problem-solving procedures, students appear to value technologies that provide immediate explanations and guidance. However, the relatively lower means related to learner control and skillfulness suggest that students may still require orientation and practice to use AI more independently and effectively. Overall, the results emphasize that ease of use is an important factor in students' positive perceptions of AI integration in mathematics learning.

This finding is supported by Afianti and Laswadi (2024), who found that mathematics education students showed positive perceptions of AI in completing mathematics assignments, particularly in terms of usefulness and ease of use, with students agreeing that AI improved understanding and task completion. Similarly, the study of Ayanwale and Molefi (2024) revealed that perceived usefulness and perceived ease of use significantly influenced students' intention to embrace AI chatbots in higher education, showing that students adopt AI more when they find it simple and beneficial. In the study of The Emergent Role of Artificial Intelligence in Mathematics Education (2024), students reported high scores for perceived usefulness and perceived ease of use, appreciating AI for providing personalized learning, immediate feedback, and flexibility in mathematics learning. Robinos et al. (2024) also found that students in a Philippine State University showed strong positive attitudes and high perceived usefulness toward AI integration in teaching and learning processes, emphasizing that AI enhances academic efficiency and understanding. Moreover, Hwang et al. (2020) found that in ICT-integrated mathematics remedial instruction, perceived usefulness positively affected students' intention to use technology and improved learning outcomes in calculus, supporting the idea that technology acceptance improves mathematics performance.

3.2 The Level of Perceived Usefulness of AI Tools for Trigonometry Assessment in Terms of Usefulness for Learning and Mastering Core Trigonometry Topic

Table 2 presents the level of perceived usefulness of AI tools for Trigonometry assessment in terms of usefulness for learning and mastering core Trigonometry topics. The overall weighted mean is 3.63, which falls under the descriptive rating of "Agree" and is qualitatively interpreted as "High." This indicates that students generally perceive artificial intelligence as a useful tool in improving their understanding, confidence, and performance in Trigonometry. Among the indicators, the highest mean score is 3.92, corresponding to the statement "AI clarifies my doubts and questions in Trigonometry effectively," while the lowest mean score is 3.22**,** corresponding to "I feel less stressed on Trigonometry exams when using AI for preparation," interpreted as Neutral and Moderate. This suggests that AI is highly effective in concept clarification and academic support, although its effect on reducing exam-related stress is comparatively lower.

The findings imply that students recognize AI as a practical academic companion in learning Trigonometry, particularly in addressing difficult concepts and improving problem-solving skills. The high rating for AI's ability to clarify doubts

supports the idea that students benefit from immediate explanations, guided solutions, and accessible learning assistance. Indicators such as "Using AI reduces my anxiety towards Trigonometry tasks" (3.84) and "AI offers helpful assistance for my Trigonometry study" (3.81) further demonstrate that AI contributes positively to students' emotional and cognitive engagement.

*Table 2.*Perceived usefulness of AI tools for Trigonometry assessment in terms of usefulness for learning and mastering core trigonometry topic.

Indicator	Mean	Descriptive Rating	Qualitative Interpretation
AI clarifies my doubts and questions in Trigonometry effectively.	3.92	Agree	High
Using AI reduces my anxiety towards Trigonometry tasks.	3.84	Agree	High
AI offers helpful assistance for my Trigonometry study.	3.81	Agree	High
Using AI makes it easier for me to tackle new Trigonometry concepts.	3.70	Agree	High
AI has been a valuable tool in managing my Trigonometry anxiety.	3.73	Agree	High
Trigonometry difficulties are easier for me to grasp because of AI concise explanations.	3.68	Agree	High
I can break down complex Trigonometry problems into small steps with the help of AI.	3.68	Agree	High
I can monitor my development and identify my Trigonometry strengths and weaknesses with the aid of AI.	3.62	Agree	High
Using AI has positively impacted my overall attitude towards Trigonometry.	3.62	Agree	High
My ability to solve Trigonometry problems has improved thanks to AI.	3.59	Agree	High
AI makes Trigonometry more accessible and less intimidating.	3.59	Agree	High
My Trigonometry problems are successfully answered via AI.	3.51	Agree	High
It is more fun to practice	3.51	Agree	High

mathematics especially in Trigonometry using AI.			
AI helps me stay calm when working on Trigonometry problems.	3.46	Neutral	Moderate
I feel less stressed on Trigonometry exams when using AI for preparation.	3.22	Neutral	Moderate
Weighted Mean	3.63	Agree	High

Additionally, the responses show that AI helps students break down complex Trigonometry problems into manageable steps, making learning less intimidating and more structured. However, the relatively lower mean for stress reduction during exams suggests that while AI supports preparation, students may still experience test anxiety due to performance pressure, time constraints, or lack of confidence during actual examinations.

The result signifies that AI tools are becoming valuable instructional supports in mathematics education, especially in Trigonometry where abstract concepts often challenge students. Students perceive AI not only as a source of academic assistance but also as a confidence-building mechanism that improves motivation and learning attitudes. This supports the view that AI fosters independent learning by allowing students to review lessons, ask questions freely, and receive personalized explanations without fear of judgment. The moderate result on exam stress reduction may indicate that emotional readiness during examinations requires more than technological support, including teacher encouragement, study habits, and self-regulation strategies. Overall, the high perceived usefulness of AI suggests that integrating AI tools into mathematics instruction can enhance both conceptual mastery and student engagement when properly guided by educators.

The findings are supported with the study of Holmes et al. (2019) which explained that artificial intelligence improves personalized learning by providing adaptive feedback and individualized academic support, helping students better understand difficult subjects such as mathematics. Zawacki-Richter et al. (2019) also found that AI-based educational tools significantly improve learning outcomes by offering immediate responses and customized instruction, which aligns with students' perception that AI clarifies doubts effectively. While Chan and Hu (2023) emphasized that AI-powered systems enhance students' engagement and confidence in mathematics by reducing learning barriers and promoting self-paced study. Similarly, Luckin et al. (2016) stated that AI supports learners by identifying weaknesses and providing targeted interventions, making complex topics more

Rating	*Range*	*Descriptive Rating*	*Qualitative Interpretation*
5	*4.50 – 5.00*	*Strongly Agree*	*Very High*
4	*3.50 – 4.49*	*Agree*	*High*
3	*2.50 – 3.49*	*Neutral*	*Moderate*
2	*1.50 – 2.49*	*Disagree*	*Low*
1	*1.00 – 1.49*	*Strongly Disagree*	*Very Low*

manageable and less stressful. Furthermore, Kohnke (2021) highlighted that AI-assisted learning increases learner autonomy and motivation because students can access explanations anytime, which is especially useful in challenging subjects like Trigonometry. These studies strongly support the present findings that AI is perceived as highly useful for mastering core Trigonometry topics and improving academic performance.

3.3 Level of Perceived Usefulness of AI in terms of Improvement of Problem-Solving Skills in Trigonometry

The data presented in Table 3 examines the perceived usefulness of Artificial Intelligence (AI) in improving problem-solving skills in trigonometry among second-year BSED Mathematics students. The overall weighted mean score of 3.62 falls under the descriptive rating of "Agree" and is qualitatively interpreted as "High." This indicates that students generally view AI as a valuable tool that enhances their abilities to solve trigonometric problems. Specific indicators

include AI assisting in breaking down complex problems into manageable steps which has a mean of 3.92, making practice more enjoyable with a mean of 3.86, and helping develop problem-solving strategies with a mean of also 3.86. Other factors include tracking progress, increasing motivation, providing clear explanations, and boosting confidence, with most statements receiving ratings in the "Agree" range.

The high levels of agreement indicate that AI integration positively influences students' learning in trigonometry by simplifying complex tasks and fostering motivation and confidence. The highest mean for AI's ability to break down complex problems suggests that AI effectively scaffolds students' understanding and reduces cognitive overload. Moderate ratings for motivation and attitude improvement show room for further enhancement in engagement. Overall, the data imply that AI tools personalize learning and provide systematic support to students, which leads to better problem-solving outcomes and increased academic performance in trigonometry.

This study suggests that AI technology acts as a pedagogical aid that not only helps students comprehend and solve intricate trigonometric problems but also strengthens their self-regulated learning strategies by monitoring their progress and identifying weaknesses. The positive qualitative interpretations reveal that AI-enabled learning environments are conducive to enhancing both cognitive and affective dimensions of students' learning

Table 3. Perceived usefulness of AI in terms of improvement of problem-solving skills in Trigonometry.

Indicator	Mean	Descriptive Rating	Qualitative Interpretation
Artificial Intelligence (AI) assists me in breaking down complex Trigonometry problems into manageable steps.	3.92	Agree	High
Using Artificial Intelligence (AI) makes Trigonometry practice more enjoyable.	3.86	Agree	High
Artificial Intelligence (AI) helps me develop problem-solving strategies in Trigonometry.	3.86	Agree	High
Artificial Intelligence (AI) helps me track my progress and understand my strengths and weaknesses in Trigonometry.	3.84	Agree	High
I find that Artificial Intelligence (AI) keeps me composed when doing Trigonometric issues.	3.81	Agree	High
Artificial Intelligence (AI) provides clear explanations that help me understand Trigonometry problems.	3.62	Agree	High
When I use Artificial Intelligence (AI), my motivation to study mathematics increases.	3.62	Agree	High
Artificial Intelligence (AI) provides adequate support for my learning in Trigonometry.	3.59	Agree	High
I feel more confident when solving Trigonometry problems because of	3.57	Agree	High

Artificial Intelligence (AI).			
Artificial Intelligence (AI) helps me better understand complex Trigonometry concepts.	3.54	Agree	High
I am more motivated to study Trigonometry when using Artificial Intelligence (AI).	3.46	Neutral	Moderate
I find it easier to approach new Trigonometry topics with the help of Artificial Intelligence (AI).	3.43	Neutral	Moderate
My attitude toward mathematics has improved overall due to using Artificial Intelligence (AI).	3.41	Neutral	Moderate
Using Artificial Intelligence (AI), I have become more proficient at handling Trigonometric issues independently.	3.38	Neutral	Moderate
Using Artificial Intelligence (AI) has made me more independent in solving Trigonometry problems.	3.32	Neutral	Moderate
Weighted Mean	3.62	Agree	High

Rating	*Range*	*Descriptive Rating*	*Qualitative Interpretation*
5	*4.50 – 5.00*	*Strongly Agree*	*Very High*
4	*3.50 – 4.49*	*Agree*	*High*
3	*2.50 – 3.49*	*Neutral*	*Moderate*
2	*1.50 – 2.49*	*Disagree*	*Low*
1	*1.00 – 1.49*	*Strongly Disagree*	*Very Low*

This indicates a shift towards more interactive and adaptive mathematical instruction, where AI tools equip students with the necessary skills for autonomous and effective problem-solving.

According to Li & Ma (2019) found that AI-based tutoring systems significantly improve students' problem-solving skills in mathematics by personalizing feedback and scaffolding learning tasks. Chen et al. (2020) demonstrated that integrating AI technologies in math education enhances learners' motivation and engagement, correlating with higher academic achievement. While, Usluel, & Mazman (2017) reported AI as an influential factor in increasing students' autonomy in complex problem areas through adaptive learning platforms. Furthermore, Kim & Hannafin (2019) highlighted the role of AI in providing immediate and clear explanations, which aids comprehension and retention in STEM subjects. Zhang et al. (2021) confirmed that AI tools enable continuous progress monitoring and personalized learning plans, fostering confidence and independence in problem-solving.

3.4 Level of Student Engagement in Trigonometry

This part presents the level of student engagement in Trigonometry among BSEd Mathematics students of Don Carlos Polytechnic College. It includes three components, namely: affective engagement, behavioral engagement, and cognitive engagement. It shows the mean, descriptive rating, and qualitative interpretation of the data gathered from the respondents. It reveals how students engage in learning Trigonometry in terms of their emotions, participation, and cognitive involvement in classroom activities and learning tasks.

Table 4. Student engagement in Trigonometry among BSED Math students in terms of affective engagement.

Indicator	Mean	Descriptive Rating	Qualitative Interpretation
I put effort into completing	4.11	Agree	High

Trigonometry learning activities.			
I like what I am learning in Trigonometry.	3.73	Agree	High
I enjoy learning new Trigonometry concepts in class with the help of AI.	3.73	Agree	High
Most days, I look forward to attending my Trigonometry class.	3.70	Agree	High
I think what we are learning in Trigonometry is interesting when supported by AI.	3.65	Agree	High
I like my Trigonometry class when AI tools are integrated into learning.	3.54	Agree	High
I am happy to be in my Trigonometry class when AI tools are used.	3.49	Neutral	Moderate
I am very interested in learning Trigonometry when AI tools are used.	3.43	Neutral	Moderate
I am proud to be enrolled in Trigonometry course that uses AI tools.	3.35	Neutral	Moderate
I think learning Trigonometry is boring even when AI tools are used.	2.51	Neutral	Moderate
Weighted Mean	3.52	Agree	High

Rating	*Range*	*Descriptive Rating*	*Qualitative Interpretation*
5	*4.50 – 5.00*	*Strongly Agree*	*Very High*
4	*3.50 – 4.49*	*Agree*	*High*
3	*2.50 – 3.49*	*Neutral*	*Moderate*
2	*1.50 – 2.49*	*Disagree*	*Low*
1	*1.00 – 1.49*	*Strongly Disagree*	*Very Low*

Table 4 shows the level of student engagement in Trigonometry among BSED Math students in terms of affective engagement. The overall weighted mean is 3.52, which is described as "Agree" and qualitatively interpreted as High. This indicates that students generally demonstrate positive emotions toward learning Trigonometry when supported by AI tools. Among the

indicators, the highest mean is 4.11 that indicates "I put effort into completing Trigonometry learning activities", followed by 3.73 which indicates "I like what I am learning in Trigonometry" and "I enjoy learning new Trigonometry concepts with AI", all interpreted as High. Meanwhile, some indicators such as feeling proud with a mean of 3.35, being very interested with a mean of 3.43, and feeling happy with a mean of 3.49 fall under Neutral or Moderate levels. The statement about boredom has a mean of 2.51, indicating a lower tendency toward negative feelings.

The data revealed that students show strong effort, interest, and enjoyment in learning Trigonometry, especially when AI tools are integrated into instruction. High mean scores in effort and enjoyment suggest that AI enhances students' motivation and makes learning more engaging. However, the decline in scores related to deeper emotional aspects such as pride, happiness, and strong interest suggests that engagement is more surface-level rather than deeply internalized. While AI tools appear effective in improving participation and enjoyment, they are less effective in shaping students' long-term emotional attachment or identity toward the subject. This contrast indicates that students may appreciate AI as a helpful support tool but do not necessarily develop a strong emotional connection to Trigonometry itself.

The findings imply that AI integration positively influences students' affective engagement by increasing their effort, enjoyment, and classroom interest. However, it does not fully cultivate deeper emotional outcomes such as pride, passion, or intrinsic motivation. This suggests that while technology enhances the learning experience, it cannot replace the need for meaningful teaching strategies that foster emotional connection and personal relevance. Students may view AI as a facilitator of learning rather than a factor that transforms their attitude

toward mathematics. Therefore, teachers should combine AI tools with student-centered, interactive, and emotionally engaging approaches to strengthen overall affective engagement.

Selwyn (2016) argued that educational technologies can improve how students learn but do not automatically change how they feel about a subject, supporting the moderate scores in deeper affective indicators. Schindler et al. (2017) found that technology enhances student engagement, particularly in increasing interest and participation, which aligns with the high ratings in effort and enjoyment. Bond and Bedenlier (2019) emphasized that digital tools improve engagement but often at a behavioral or surface level, consistent with the observed pattern in the data. Naz and Dwivedi (2023) reported that integrating digital technologies increases student motivation and engagement, but deeper emotional connection requires intentional instructional design. Similarly, Ren et al. (2026) highlighted that AI-supported learning environments enhance motivation and engagement, yet the development of intrinsic interest depends on how these tools are pedagogically implemented.

3.5 The Level of Student Engagement in Trigonometry among BSED Math Students in terms of Behavioral Engagement

Table 5 . Student engagement in Trigonometry among BSED Math students in terms of behavioural engagement.

Indicator	Mean	Descriptive Rating	Qualitative Interpretation
In Trigonometry class, I work as hard as I can.	4.24	Agree	High
If I have trouble understanding Trigonometry problem, I go over it again until I understand it.	4.11	Agree	High
I pay attention during Trigonometry lessons, even when AI tools are used.	4.00	Agree	High
When I encounter a difficult Trigonometry homework problem, I keep working on it until I think I have solved it.	3.86	Agree	High
When I am in Trigonometry class, I actively participate in class activities.	3.78	Agree	High
When I am in Trigonometry class, I act just like I am working.	3.73	Agree	High
I try hard to do well in Trigonometry when using AI tools.	3.68	Agree	High
In Trigonometry, I do just enough to get by.	3.54	Agree	High
During Trigonometry class, my mind wanders even when AI tools are used.	3.46	Neutral	Moderate
I actively participate in school or academic activities related to Trigonometry.	3.35	Neutral	Moderate
I volunteer to help with school or academic activities	3.14	Neutral	Moderate

related to Mathematics or Trigonometry.			
I take an active role in extracurricular activities that involve Mathematics or problem-solving.	3.14	Neutral	Moderate
Weighted Mean	3.67	Agree	High

Rating	*Range*	*Descriptive Rating*	*Qualitative Interpretation*
5	*4.50 – 5.00*	*Strongly Agree*	*Very High*
4	*3.50 – 4.49*	*Agree*	*High*
3	*2.50 – 3.49*	*Neutral*	*Moderate*
2	*1.50 – 2.49*	*Disagree*	*Low*
1	*1.00 – 1.49*	*Strongly Disagree*	*Very Low*

Table 5 presents the level of student engagement in Trigonometry among BSED Math students in terms of behavioral engagement. The overall weighted mean is 3.67, which is described as "Agree" and qualitatively interpreted as High. This indicates that students generally demonstrate active participation, effort, and persistence in Trigonometry classes when AI tools are integrated. The highest mean is 4.24 that indicates "I work as hard as I can", followed by 4.11 the indicator "I go over problems until I understand them", and

4.00 which indicate "I pay attention during lessons", all interpreted as High. However, some indicators such as mind wandering (3.46), participation in academic-related activities (3.35), volunteering (3.14), and extracurricular involvement (3.14) fall under Neutral or Moderate levels.

The data show that students are highly engaged behaviorally within the classroom, particularly in terms of effort, persistence, and attention. High mean scores in working hard, reviewing difficult problems, and maintaining focus suggest that AI tools support students in staying on task and completing learning activities effectively. However, the lower scores in extracurricular involvement and voluntary participation indicate that engagement tends to decline outside structured classroom settings. This suggests that while students are compliant and active during required tasks, they are less likely to extend their engagement beyond what is expected. The presence of a relatively high mean (3.54) for "doing just enough to get by" also implies that some students may still demonstrate minimal effort despite the overall high engagement.

The findings imply that AI integration positively enhances students' behavioral engagement, particularly in structured classroom environments where tasks are guided and required. Students demonstrate strong effort, persistence, and attention, which are essential for academic success. However, the moderate levels of engagement in voluntary and extracurricular activities suggest that students' motivation may still be externally driven rather than intrinsic. This means that while AI tools help maintain on-task behavior, they may not be sufficient to encourage self-initiated or sustained engagement beyond the classroom. Therefore, educators should design more interactive, real-world, and collaborative activities that motivate students to engage actively both inside and outside the classroom.

Schindler et al. (2017) found that educational technologies enhance students' participation, attention, and active involvement, which aligns with the high behavioral engagement observed in the classroom. Bond and Bedenlier (2019) emphasized that behavioral engagement, such as effort and persistence, is strongly influenced by technology-supported learning environments. Martin and Bolliger (2018) highlighted that students show higher engagement when learning activities are interactive and meaningful, supporting the high levels of participation during class. However, they also noted that engagement beyond required tasks needs additional strategies. Sun and Rueda (2019) reported that technology can improve students' motivation and persistence, but sustaining engagement outside formal instruction requires intentional design. More recently, Salhab and Aboushi (2026) found that AIenhanced learning increases student

participation and task completion, but deeper and self-directed engagement depends on how activities are structured.

3.6 The Level of Student Engagement in Trigonometry among BSED Math Students in terms of Cognitive Engagement

Table 6 presents the level of student engagement in Trigonometry among BSED Math students in terms of cognitive engagement. The overall weighted mean is 3.89, which is described as "Agree" and qualitatively interpreted as High. This indicates that students are actively involved in understanding, analyzing, and applying Trigonometry concepts when AI tools are used. The highest mean is 4.14 "I try to relate Trigonometry to concepts learned in other math subjects", followed by 4.00 ("I match what I already know with what I am learning" and 3.97 "I think about real-life applications", all interpreted as High. The lowest mean is 3.57 "I make my own examples", but it still falls under the High level, showing consistency across all indicators.

Table 6. Student engagement in Trigonometry among BSED Math students in terms of cognitive engagement.

Indicator	Mean	Descriptive Rating	Qualitative Interpretation
When learning Trigonometry, I try to relate it to concepts I learned in other math subjects.	4.14	Agree	High
I try to match what I already know with what I am trying to learn in Trigonometry.	4.00	Agree	High
When I study Trigonometry, I think about how the concepts might be useful in real-life situations.	3.97	Agree	High
When learning Trigonometry, I try to see how new ideas fit together with what I already know.	3.95	Agree	High
When I study Trigonometry, I try to connect what I am learning with my own experiences.	3.92	Agree	High
I try to see the similarities and differences between Trigonometry concepts and what I already know.	3.92	Agree	High
I try to understand how the Trigonometry topics I learn fit together.	3.92	Agree	High
I think through Trigonometry topics carefully rather than just memorizing formulas.	3.92	Agree	High
When I study Trigonometry, I try to understand	3.86	Agree	High

the materials by relating it to what I already know.			
When studying Trigonometry, I try to combine different ideas to better understand the lesson.	3.76	Agree	High
When learning new Trigonometry topics, I try to put the ideas into my own words.	3.70	Agree	High
I make my own examples to help me understand important Trigonometry concepts.	3.57	Agree	High
Weighted Mean	3.89	Agree	High

Rating	*Range*	*Descriptive Rating*	*Qualitative Interpretation*
5	*4.50 – 5.00*	*Strongly Agree*	*Very High*
4	*3.50 – 4.49*	*Agree*	*High*
3	*2.50 – 3.49*	*Neutral*	*Moderate*
2	*1.50 – 2.49*	*Disagree*	*Low*
1	*1.00 – 1.49*	*Strongly Disagree*	*Very Low*

The data reveal that students demonstrate strong cognitive engagement, particularly in connecting prior knowledge, applying concepts, and engaging in higher-order thinking. High scores in relating ideas, organizing knowledge, and reflecting on real-life applications suggest that AI tools support deeper learning processes and critical thinking. The consistency of "High" ratings across all indicators indicates that students are not merely memorizing formulas but are actively processing and understanding the material. However, slightly lower means in generating personal examples and rephrasing ideas suggest that some students may still rely on guided instruction rather than fully independent thinking and knowledge construction.

The findings imply that AI integration is highly effective in promoting cognitive engagement among students. Learners are able to analyze problems, connect concepts, and think critically about Trigonometry, which are essential skills for meaningful learning. The results suggest that AI tools help facilitate deeper understanding by supporting personalized and interactive learning experiences. However, the slightly lower scores in self-generated strategies indicate a need for teaching approaches that further encourage independent thinking, creativity, and knowledge construction. This means that while AI enhances cognitive processes, teachers still play a crucial role in designing tasks that push students toward higher levels of intellectual engagement.

Schindler et al. (2017) found that educational technologies enhance cognitive engagement by promoting active learning, critical thinking, and knowledge construction. Bond and Bedenlier (2019) emphasized that digital tools support deeper learning by encouraging students to process and apply information rather than memorize it. Sun and Rueda (2019) highlighted that technology integration improves students' motivation and cognitive involvement, especially in problem-solving tasks. Meng et al. (2025) explained that AI-based tools optimize cognitive load and personalize learning, allowing students to better understand complex concepts. Similarly, Ren et al. (2026) found that AI-supported learning environments enhance students' attention, reasoning, and sustained cognitive engagement.

3.7 The Level of Academic Performance of BSED MATH 2

Table 7 presents the distribution of students' academic performance in trigonometry based on their grades. The results show an overall mean of 1.98, which is qualitatively interpreted as "Good**,"** indicating that, on average, students demonstrate satisfactory performance in the subject. Most respondents fall under the "Good" category, particularly in the grade ranges of 1.75 (27%) and 2.00 (40.54%), comprising a total of 67.54% of the students. This is followed by 5.41% who obtained

a "Very Good" rating (1.25), while no students achieved an "Excellent" rating (1.00). Meanwhile, 16.22% are classified as "Average" (2.25), 8.11% as "Fair" (2.50), and 2.70% as "Poor" (2.75).

Table 7. Academic performance of BSED MATH Students.

Range	Frequency	Percentage	Qualitative Description
1.00	0	0%	Excellent
1.25	2	5.41%	Very good
1.50	0	0%	Very good
1.75	10	27%	Good
2.00	15	40.54%	Good
2.25	6	16.22%	Average
2.50	3	8.11%	Fair
2.75	1	2.70%	Poor
3.00	0	0%	Passing
5.00	0	0%	Failed
Total	37	100%	
Mean= 1.98			Good

Notably, no respondents fall under the "Passing" (3.00) or "Failed" (5.00) categories, indicating that all students were able to meet at least the minimum academic requirements in trigonometry. This concentration of students in the "Good" category suggests that most learners demonstrate adequate understanding and application of mathematical concepts, which is consistent with findings that student performance often clusters in mid-level achievement ranges (Tantoy, 2025).

However, the relatively low percentage of students achieving "Very Good" and the absence of "Excellent" performance indicate that only a few learners reach advanced levels of mastery and higher-order thinking skills, which are essential for deeper mathematical understanding (Wang et al., 2024).

At the same time, the presence of students in the "Average," "Fair," and "Poor" categories, although minimal, suggests that some learners may experience difficulties in mastering complex topics, possibly due to differences in prior knowledge, engagement, or learning strategies (Tertulino & Almeida, 2025).

The absence of failing grades may also reflect the effectiveness of instructional support and assessment practices in ensuring minimum competency among students (OECD, 2025). These findings imply that while overall performance is satisfactory, there is still a need for both enrichment opportunities for higher-performing students and targeted interventions for those who are struggling, as early support and differentiated instruction are crucial in improving academic outcomes (Boumi & Vela, 2022).

3.8 Correlation Analysis Between the Academic Performance, Perceive Usefulness, and Student Engagement

Table 8. Correlation analysis between the Perceive Usefulness of AI and Academic Performance.

Variables	Correlation Probability (r)	Coefficient (p)
Perceive Usefulness of AI	.170	$.315^{ns}$
Ease Of Use Learning And Mastering Core Trigonometry Topics.	.254	$.130^{ns}$
	.152	$.370^{ns}$
Improvement of Problem-Solving Skills.	.077	$.649^{ns}$

$ns - not\ significant \quad * - p < 0.05 \quad ** - p < 0.01$

Table 8 presents the correlation analysis between the perceived usefulness of artificial intelligence and students' academic performance in trigonometry. The table shows that perceived usefulness of artificial intelligence obtained a correlation coefficient (r) of 0.170 with a probability value (p) of 0.315, which is marked as not significant (ns). Specifically, in terms of ease of use, learning and mastering core trigonometry topics, and improvement of problem-solving skills. The results show that ease of use (r = 0.254, p = 0.130), learning and mastering core topics (r = 0.152, p = 0.370), and improvement of problem-solving skills (r = 0.077, p = 0.649) all have no significant relationship with academic performance.

The findings indicate that there is a weak positive relationship and nonsignificant relationship between perceived usefulness of AI and academic performance among the respondents. Although students may perceive AI as useful in learning mathematics, mastering trigonometry topics, and improving problem-solving skills, these perceptions do not necessarily correspond to higher academic achievement. The positive but weak correlation suggests that the relationship between the variables is extremely minimal and insufficient to establish a meaningful connection. Furthermore, the probability values greater than 0.05 confirm that the observed relationship may have occurred by chance and does not provide enough evidence to conclude that perceived usefulness of AI significantly affects academic performance. This implies that students' positive perceptions toward AI tools alone are not enough to improve their academic outcomes in mathematics.

The findings imply that while students may perceive AI tools as useful, these perceptions alone do not necessarily translate into better academic outcomes. This may indicate that perceived usefulness is not sufficient without effective application, proper guidance, or integration into structured learning strategies. Students might use AI tools passively or rely on them without deeply engaging in the learning process, which limits their impact on performance.

Similarly, 's extended studies by Scherer et al., (2019) emphasize that perceived usefulness alone does not guarantee improved outcomes without actual usage behavior.

Furthermore, Scherer et al. (2019) found that while students may view technology positively, its effect on achievement depends on how it is used in learning contexts. Lai and Bower (2019) also reported that technology integration must be aligned with instructional design to impact learning outcomes. Holmes et al. (2019) explained that AI in education enhances learning only when it promotes active engagement and higher-order thinking.

Likewise, Zawacki-Richter et al. (2019) highlighted that AI tools are often underutilized in ways that directly affect academic achievement.

3.9 Correlation analysis between Students Engagement and Academic Performance.

Table 9. Correlation analysis between Students Engagement and Academic Performance.

Variables	Correlation Coefficient (r)	Probability (P)
Student Engagement	.216	$.199^{ns}$
Affective Engagement	.291	$.080^{ns}$
Behavioral Engagement	.220	$.190^{ns}$
Cognitive Engagement	.045	$.792^{ns}$

$ns - not\ significant \quad * - p < 0.05 \quad ** - p < 0.01$

Table 9 presents the correlation analysis between student engagement and their academic performance in trigonometry. The table shows that student engagement obtained a correlation coefficient (r) of 0.216 with a probability value (p) of 0.199, which is marked as not significant (ns). Specifically, affective, behavioral, and cognitive engagement. The results show that affective engagement (r = -0.291, p = 0.080), behavioral engagement (r = 0.220, p = 0.190), and cognitive engagement (r = -0.045, p = 0.792) all have no significant relationship with academic performance.

The findings indicate that there is a positive but weak and non-significant relationship between student engagement and academic performance among the respondents. Affective, behavioral, and cognitive engagement all show positive correlations with academic performance; however, these relationships are weak to very weak, suggesting only minimal increases in performance as engagement increases. Affective engagement shows a weak positive relationship, behavioral engagement also shows a weak positive relationship, while cognitive engagement shows a very weak or negligible positive relationship. Since all probability values are greater than 0.05, the results are not statistically significant, indicating that the observed positive relationships may have occurred by chance and do not provide sufficient evidence of a meaningful

relationship between student engagement and academic performance.

This implies that engagement alone may not be enough to improve academic performance unless accompanied by effective study habits, selfregulation, instructional quality, and deeper conceptual understanding.These findings suggest that students' engagement whether emotional (affective), participatory (behavioral), or mental effort (cognitive) does not directly influence their academic performance in trigonometry. This may indicate that engagement alone is not enough to improve performance unless it is supported by effective study habits, time management, and instructional quality. Students may be engaged but not necessarily applying effective learning strategies that lead to higher achievement.

This result aligns with several studies. Fredricks et al. (2016) emphasized that while engagement is important, its relationship with academic achievement is complex and influenced by other factors such as teaching quality and self-regulation. Bond et al. (2020) found that student engagement does not always directly lead to improved academic performance, especially in technology-enhanced learning environments. Similarly, Sinatra et al. (2020) noted that engagement must be paired with deep cognitive processing to impact achievement. Areepattamannil and Freeman (2018) also reported that engagement does not consistently predict academic success across contexts. Meanwhile, Mega et al. (2020) explained that engagement influences performance indirectly through motivation and self-regulated learning rather than having a direct effect.

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