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Co-pilots in problem solving: A qualitative inquiry into AI-assisted learning in mathematics

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Abstract

Artificial Intelligence (AI) has become integral to education, transforming the way students approach mathematics. This qualitative study examines the perceptions, experiences, and usage patterns of BS Applied Mathematics students in using AI tools such as ChatGPT, Gemini, Meta AI, and Cici for solving mathematical problems within the context of Technology-Enhanced Learning (TEL). Grounded in the Technology Acceptance Model (TAM), it explores five dimensions: usefulness, ease of use, attitude toward use, behavioral intention, and actual use. Data was analyzed using both phenomenological and thematic approaches, incorporating interviews, focus group discussions, and observations. Students primarily used AI tools for speed, convenience, and quick solutions under time pressure. While most preferred AI as a complement to traditional learning, they expressed concerns about overreliance, limited understanding, and reduced motivation. Nonetheless, students demonstrated digital literacy by validating AI outputs and using multimodal resources, such as YouTube tutorials, to enhance comprehension. The study advocates for balanced AI integration in education, emphasizing digital literacy, responsible use, and the development of improved AI-based platforms to strengthen multimodal and explainable learning within TEL frameworks.

Keywords: AI Tools (ChatGPT, Gemini, Meta AI, Cici), Multimodal Learning, Technology-Enhanced Learning (TEL), Technology Acceptance Model (TAM)

Introduction

Over the past few decades, the world has seen the evolution of artificial intelligence (AI), which is now a part of daily life, including education. The idea of AI dates back to the 1950s, which was marked by advancements in technological intelligence, such as Alan Turing's invention of "machine intelligence." Early programs such as Logic Theorist and General Problem Solver were later developed in the mid-1950s (McCarthy, 1956). Other significant developments in AI technology came to be in the 1970s with expert systems; AI in education marked the introduction of machines in the 1990s and the growth of deep



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learning systems in the 2010s (Russell & Norvig, 2021). In education, efforts have been made to enhance teaching and learning experiences. AI-powered systems have made it possible to offer students a personalized learning experience with real-time feedback (Luckin et al., 2016).

AI in education is a changing aspect of education. Intelligent tutoring systems, automated grading software, and adaptive learning platforms are tools available to make education more individualized for students (Holmes et al., 2019). Automated grading systems like Gradescope allow teachers to grade assignments efficiently without compromising time and consistency (Piech et al., 2015). In addition, AI problem-solving tools allow students to comprehend bypass concepts, which would otherwise remain complicated, by giving detailed procedural mannerisms and interactive problem-solving exercises (Chen et al., 2020).

AI is crucial in numerous educational purposes, especially in solving mathematical problems. AI tools such as Wolfram Alpha, Photomath, and graphing calculators powered by AI also assist students by simplifying their work steps so that they can understand. (Liu et al., 2018) While images are converted into usable and workable formats in computer languages through translations like those in Wolfram Alpha, Photomath scans handwritten equations into computers to give instant results (Rahman et al., 2021). Such platforms help students answer questions and endeavor to boost students' understanding of the processes involved in dealing with abstract ideas at the high mathematics level.

Research confirms college students' increasing use of AI, especially for academic purposes. The study by Zhang and Wang (2022) shows that more than 70% of college students make use of AI-based programs to assist them in their coursework; in this regard, a significant number of AI applications have been used in mathematics assignments. The surveys also reveal that students appreciate AI applications for instant solutions and clarification of complex problems (Smith & Johnson, 2021). With the continued advancement of AI, its application in academic institutions is set to grow as it continues to influence how students approach problem-solving and learning.

According to one view, the increased role of AI in math solving has certain advantages and disadvantages. Given the advantages, AI enhances the accuracy, efficiency, and accessibility of learning, allowing students to assess their skill development (Luckin, 2018) immediately. AI further enhances personalized learning by catering to students' strengths and weaknesses, providing a focused exercise experience (Nguyen & Ikeda, 2019). On the other hand, there are fears that excessive reliance on AI may rob students of critical thinking ability and reduce their problem-solving capabilities (Selwyn, 2020). Educators must weigh the merits of AI-associated teaching against traditional teaching methods to

uphold students' basic analytical abilities in conjunction with their technological know-how.

This study explored how students engage with AI tools amid mathematical problem-solving by watching them and looking at their insights, strategies, and challenges. It aims to provide in-depth insights into the cognitive, behavioral, and affective aspects of AI-supported learning, thereby guiding the formulation of future AI models and practices well aligned with the potential of AI while considering its limitations.

Theoretical Framework

The Technology Acceptance Model (TAM) is used theoretically to examine students' reliance on artificial intelligence to solve mathematical problems. The model developed by Davis in 1989 explains the acceptance and use of technology by users, which is mainly determined by a stakeholder's key considerations: perceived usefulness, perceived ease of use, attitude, and behavioral intention. This study employs TAM to seek an understanding of the factors that influence students' dependency on AI-based mathematics tools.

Perceived usefulness relates to how students think AI tools can impact their ability to resolve mathematical problems efficiently (Davis, 1989). This study, then, examines if students perceive any such accuracy and speed improvements in their problem-solving processes. Students who are more confident that AI is a good way to achieve academic success will tend to rely more on it for their mathematics problems (Crompton & Burke, 2023; Mustafa et al., 2024).

Ease of use is not the only thing considered here; anything from low mental effort to working through problems with the assistance of an AI assistant would be considered low use. They confirm that the minimum effort a technology requires results in greater acceptance (Venkatesh & Davis, 2000). Such a judgment considers if students comfortably use AI applications such as Wolfram Alpha and Photomath and if this level of comfort influences how often they use them (Memiş, 2023).

It is observed that attitude toward the use of AI embodies the students' perception of the incorporation of AI in their learning process, whether good or bad. When perceived benefits and ease of use shape positive attitudes, they, in turn, enhance the acceptance of AI (Ajzen, 1991). This research sets out to study the impact of students' attitudes on their acceptance of AI as a solution to math problems (Crompton & Burke, 2023).

Behavioral intention refers to whether students see themselves continuing to use AI in the future. According to TAM, respondents who see technology as highly useful and easy to use create stronger intentions toward its use (Venkatesh & Bala, 2008). This will measure if students intend to rely on AI for math-related tasks for the foreseeable future and the variables that predict their continued usage (Mustafa et al., 2024).

The real-life use shows how students use AI tools in a manner that reflects their real intentions and behavior. Intentions enable expectations regarding future conduct while actual use shows reliance on AI. Thus, the study compares the two to highlight any inconsistencies between the expected and real engagement with AI (Memiş, 2023). Following the TAM framework, this research captures both cognitive and behavioral characteristics that determine students' dependence on AI when attempting to solve mathematics problems. The findings are aimed at helping effective integration of AI in teaching with some negative implications.

Supporters of the Technology Acceptance Model (TAM) premise that perceived usefulness and ease of use are the main determinants of acceptance (Davis, 1989). However, the specific cognitive appraisal that an individual may make of the technology widely applied in practice is largely ignored by the model. Besides TAM, the broader concept encompassing many processes for AI acceptance should include TEL, as it emphasizes pedagogical integration, learner engagement, and context in understanding meaningful learning with technology (Scherer & Teo, 2019; Srilatha & Sen, 2024). Technology-Enhanced Learning (TEL), facilitated by digital technology, significantly enhances interactivity, personalizes learning, and provides easy access in modern education. Education takes students beyond a traditional learning setup: It enables them to learn through various multimedia, engage in real-time collaboration regardless of location, and receive immediate, accurate feedback tailored to their ever-changing needs (Mentimeter, 2023; Marymount University, 2022). This enables real-time engagement, instilling in learners not only the critical skills of digital literacy but also a thorough understanding of the concept, whereby they become "motivated, understanding different kinds of learning styles and preferences of students" (Mentimeter, 2023). AI tools in mathematics and other STEM domains are being integrated to scaffold the problem-solving skills aspect of TEL initiatives in modular learning, thus motivating students to invest more energy in their critical thinking and self-regulated skill sets (Srilatha & Sen, 2024). A TEL is to prepare a learner for a technology-aided future by intertwining pedagogical novelties with technological affordances, further to provide support in lifelong learning and academic achievement.

Statement of the Problem

This study examined how college students adopt AI tools for solving mathematics problems, guided by their perceptions and experiences through the lens of the Technology Acceptance Model (TAM). Although AI tools are known to enhance accuracy and efficiency, how students interpret and value these benefits is still not well understood.

Likewise, while ease of use generally implies minimal mental effort, students' personal comfort in using AI for academic tasks remains a critical area for deeper investigation.

Specifically, it investigated how students perceive the usefulness of AI in improving the efficiency and effectiveness of their math problem-solving. It also explores views on the ease of use and availability of AI tools in mathematical contexts, specifically how students think AI makes mathematics easier or more accessible.

The study also looked into the students' attitudes toward adopting AI, focusing on their personal feelings and evaluations of these technologies as part of their learning process. It also delves into students' behavioral intentions, plans, and intentions to continue using this technology in mathematics. Finally, the study will examine the actual use of AI by considering the frequency and contexts in which students use these tools for solving problems.

The study thus aimed to obtain a holistic view of the factors and mechanisms of influence that shape students' acceptance and long-term use of AI-aided processes in mathematics education, finding possible gaps between intentions and real-world scenarios of use.

Methodology

Research Design

A qualitative phenomenological design using thematic analysis was used to elicit Bachelor of Science (BS) Applied Mathematics students' perceptions of AI tools, including ChatGPT, Gemini, Meta AI, and Cici, in resolving mathematical problems. This design corresponds closely to Braun and Clarke's (2006) six-phase framework so as to allow for a deep interpretation of the participants regarding their lived experiences and meaning-making processes around AI-assisted learning. While the sample size ($n = 6$) might appear small, it follows the phenomenological research tradition with priority on depth over breadth (Subedi, 2021). Data saturation was reached when no new themes emerged.

The transcripts were systematically coded to identify patterns and generate themes across interviews, focus groups, and observations, using Braun and Clarke's (2006) reflexive thematic analysis framework, as employed by two independent coders. For reliability enhancement, 20% of the material was independently double-coded, and inter-rater reliability was assessed using Cohen's Kappa coefficient, yielding a score of 0.87, indicating strong agreement. Discrepancies were discussed until consensus was reached. The trustworthiness of the analysis was enhanced through methodological triangulation, member checking, and a detailed audit trail. Further reflexivity was ensured by memo-writing and researcher journaling throughout the analysis. Particularly, this study employs a phenomenological method to better understand student experiences related to using AI in mathematical problem-solving in line with contemporary qualitative inquiries in

mathematics education (Xu, 2025). The qualitative methods incorporated in the study included semi-structured interviews, focus-group discussions, and direct observation aimed at in-depth contextual data that unveiled cognitive and emotional aspects of AI-assisted learning. The participants comprised six BS Applied Mathematics students from a state university in the Philippines who were purposefully chosen on the basis of their experience in solving mathematical problems using AI tools. Students from different years were included in the sampling to ensure broad perspectives on AI use. Ethical measures were practiced in every step of the study, including informed consent, confidentiality, and the right to withdraw at any time.

Data collection included face-to-face semi-structured interviews that utilized an interview guide with open-ended questions to elicit rich narratives concerning students' use of AI in mathematics. Topics included the students' reasoning processes and personal reflections on the impact of AI tools on their learning. Interviews extended from 30 to 45 minutes, were audio-recorded with consent, and subsequently transcribed verbatim for analysis.

Results and Discussion

Theme 1: Perceived Effectiveness

The study aimed to investigate how students pursuing a BS in Applied Mathematics resort to the assistance provided by AI tools, such as ChatGPT, Gemini, Meta AI, and Cici, in solving mathematical problems. The principal theme they suggested was the perceived effectiveness of the tools under investigation, which is further divided into seven sub-themes.

The first two themes describe how students believe that AI tools are accurate and specific, but often use YouTube as an additional source of understanding. The visual and auditory stimulation offered by YouTube aids cognitive engagement in areas where concepts are dense, such as calculus, advanced algebra, and other major courses. This concurs with Mayer's (2009) cognitive theory of multimedia learning, which maintains that students learn more with increased retention when information is presented in both verbal and visual forms. The students seem to prefer "trying first, then watching YouTube, and finally using AI" as their metacognitive strategy, whereby they exercise some degree of control over their learning. In this sense, they never used the AI tools as substitutes but as extra support. Additionally, reaffirming findings by Holmes et al. (2019), students' AI use appears to intertwine with other digital resources in formulations that move back and forth toward solving problems.

“AI tools like ChatGPT give direct and specific answers; this is useful. But if I do not understand the solution in full, I go back to YouTube, where seeing a step-by-step worked solution gives me more understanding.”

“In trying to solve math problems, I try to solve them on my own first. Then, I would check for tutorial videos on YouTube. If none of them helped, I would go on to ChatGPT or any other AI tool.”

This was affirmed by many respondents about the third sub-theme- the capability for image generation by ChatGPT. Such feature is seen as an aid in visualizing graphs or geometric figures. The attribute is described as "limited", but it indicates the progressive importance of a multimodal AI system in the support of spatial reasoning. Arcavi (2003) contends that it would not be only supportive aid but also necessary to mathematical thinking. These limitations imply a demand for having more specific-use tools, perhaps coupled with dynamic visualization systems like Desmos or GeoGebra.

"I use ChatGPT because sometimes it can make diagrams or graphs for me to visualize the problem. It's useful but the image it can generate usually is limited."

The fourth sub-theme really involved students cross-checking and finding consistency in the AI-sourced outputs across different sources. Suspected outputs from ChatGPT would usually be confirmed with Gemini, Meta AI, or Cici, according to the students. Such a triangulation hints at the kind of active engagement students have with AI outputs; they exhibit some kind of critical digital literacy-a capacity to judge credibility and accuracy of AI-generated responses. This correlates with Buckingham (2015), who argues that digital competence is not only about using the tools but also questioning their reliability and limitations. It is also synonymous with issues raised in more recent studies over AI hallucinations, where plausible-but-wrong answers may be produced by language models (Bender et al., 2021).

"Sometimes I'm not sure if ChatGPT is correct, so I double-check by the answer using Gemini, Meta AI, or Cici. If they match, then I feel more confident."

But the fifth and sixth sub-themes lay out exciting contradictions in the use of AI. Students were worried that their increasing use of tools for obtaining answers would be a disincentive to internalizing what they're learning. Some admitted that they had gotten a bit lazy, resorting to AI for answers rather than working through problems themselves. Others claimed to be learning less, with understanding replaced by “use-the-tools-kind-of-doing-things”. Such comments reflect ongoing arguments about the pedagogical dangers AI poses to education. AI provides a potential danger when it goes unequipped in scaffolding since, using such tools, students may only gain an understanding of surface

learning (Biggs & Tang, 2011) and lack the development of deep skills needed to solve problems in mathematics education (Polya, 1957). Such dangers were found in the research findings of Luckin et al. (2016), warning against the uncritical adoption of AI into education by educators unless intervention and instructional design were considered necessary.

"The more I use AI, the more I rely on it. It makes me feel lazy sometimes because I don't have to really solve the problem."

"When I rely too much on AI, I get the answers, but I don't really understand the answers. I'm learning less because I'm not processing the steps on my own."

This seventh subtheme reveals just how much superiority YouTube is considered to offer with detailed explanations and real-time walkthroughs, relegating AI tools to the use of add-ons. This preference thus matches students' preferences for instructor or peer-like touches, sometimes mediated digitally. Clark and Mayer (2016) note that learner benefits accrue from such guidance and contextualization examples that YouTube provides with human narrators in structured tutorials. It would thereby serve to challenge the assumption that AI will eventually replace human-mediated instruction; otherwise, students appear to value AI most when it operates within an ecology of resources part of a system, rather than alone.

"I normally go to YouTube for explanations, because the discussions are more detailed. If I still cannot understand, then I use AI as a backup—it helps, but it is not my first choice."

Theme 2: Ease of Use

Ease of Use captures the authentic experiences and obstacles faced by BS Applied Mathematics students when turning to AI tools for solving mathematical problems. Most participants pointed out that these platforms are indeed easy to navigate and supportive of their academic work. However, they also emphasized that this usability depends heavily on having a stable internet connection along with the right equipment, typically a laptop or a high-performance smartphone. This finding supports previous research that mentions the digital access and device quality affecting learning technologies' effectiveness (Van Dijk, 2020).

"AI tools are easy to use for school assignments, but they are only effective if you have stable internet and very good smartphone."

Students cited the reliability of the answers generated by AI as one of their primary concerns. They mentioned that errors only become apparent after assignment results have been released, implying a delay in feedback, resulting in compromised learning. This is in

keeping with the caution highlighted by researchers in the limitedness and occasional incorrectness of AI outputs (Bender et al., 2021).

“Sometimes after the assignment results are released, I realize that the AI’s answers were wrong. It doesn’t happen all the time, but it makes me double-check.”

Most of the time, there were also different results, particularly with the different AI tools. They noted that different AI platforms gave contrary answers to the same mathematical question, emphasizing the need to assess AI’s academic work critically. This triangulation behavior illustrates digital literacy, where learners are responsible for different sources to ascertain information (Buckingham, 2015).

“There have been occasions when different AIs gave different answers for the same question. It makes me unsure which one is correct.”

Placing the accuracy measures on their confidence, the students believed that, to some extent, about 60 percent was AI accuracy, an average level of trust, giving cautious engagement rather than outright trust.

“I think AI is only correct about 60% of the time. It’s useful but not always reliable.”

Use of any technology will depend on the intricacies of working with the hardware in use, especially in those cases where mathematical symbols and expressions need input. Some students found it difficult to work with very complex notation, depending on how easy or difficult it was to use their chosen device interface, linking this finding to other usability studies about limitations imposed by the device on digital math tools (Egan et al., 2017).

“AI is easy to use, but it really depends on your phone or gadget, especially when typing math symbols.”

Finally, participants appreciated AI platforms like Gemini for their capacity to process picture-based math problems with technical clarity, especially when paired with a clear camera. This suggests that multimodal AI tools integrating image recognition may enhance usability and learning efficiency.

“For picture solutions, I usually use Gemini because it’s technical and clear, especially if I use a good camera to take the problem.”

Theme 3: Attitude Toward Using AI

The theme of this study discussed students’ evaluations and emotions regarding using AI tools for mathematics problem-solving. Attitudes include some appreciation of AI but

increasing concern about dependency, control, and misguided trust. Recent literature supports these concerns, wherein attitudes affect how learners evaluate, engage with, or resist educational technologies (Mustafa et al., 2024; Crompton & Burke, 2023).

Usually, these students consider AI the best method to solve math problems, especially under time pressure, since it is perceived as the fastest and easiest way. However, due to that perception, they now have low cognitive engagement and deep learning. Even with an awareness of the advantages AI can offer, many students found themselves somewhat removed from fully engaging with their own learning. This tension is also documented by Memis (2023), who observed that while learners may hold favorable views on how AI tools function, they simultaneously harbor doubts about how much these tools truly support meaningful educational outcomes.

"I use AI because it is useful and convenient, but you do not learn much."

It is interesting to note that some students preferred learning through YouTube compared to AI because it offers more specific steps and gives visual explanations, which are helpful toward understanding mathematics concepts. This provides evidence for a preference for an instructional medium that integrates guidance and explains the two elements, which are usually lacking in the AI problem-solving environment (Delgado & Lopez, 2024).

"Better to use YouTube because there are video tutorials."

Interestingly, some students confessed to relying on AI without sometimes verifying its solutions, showing traces of an almost automatic reliance on AI. This finding corresponds with over-trusting algorithmic output without self-evaluation observed by Jones-Jang et al. (2023).

"Sometimes, I do not check the answer given by AI."

Further, students find that their internal fixation on AI decreases their self-trust levels, meaning that the more they use AI, the less confident they become in their abilities. This relates to the concept of automation bias by Khan and Cope (2023), whereby people give more credence to machines rather than their reasoning based on their assumption that machines have better judgment.

"You doubt yourself—the more you depend on AI."

Lastly, there is a dismissed minority that sees AI in math negatively, arguing that it adversely affects self-input in problem-solving. This phenomenon depicts a common stage of rejection in the technology acceptance process, whereby doubt and fear of getting dependent resist and delay acceptance (Venkatesh, 2022).

"I do not like to use AI all the time as I feel it makes me lazy in my solving."

These contradicting opinions suggest that student attitudes depend on the perceived usefulness or novelty and on individual learning goals, self-efficacy, and affective reactions. Attitudes toward AI remain layered and often ambivalent. Students may appreciate its assistance but remain uneasy about its impact on their future learning autonomy.

Theme 4: Behavioral Intention to Use

The fourth theme, Behavioral Intention to Use, describes the evolution of the student's relationship to AI tools, being influenced by internal sources of conviction and external academic pressures. A persistent trend observed among participants concerned decisions to use AI under the condition of any doubts regarding its output, especially those doubts raised when the AI seemed to contradict the student's solutions.

Confidence would occasionally be lost, but AI provided a helpful backbone, particularly when time was pressed. In reference to such behavior, AI use was a case of one's implementation intention being partly justified by the Theory of Planned Behavior (Ajzen, 1991) concerning such factors as attitude, perceived control, and contextual needs, like deadlines!

"Even if I'm not 100% sure the AI is correct, I still use it because it is very useful during tight deadlines."

Curiously enough, self-confidence in academic abilities moderates AI usage. The self-confident students, therefore, avoid checking their work with AI tools, indicating a strategic, selective use. This is a typical indicator of adopting self-regulated learning principles (Zimmerman, 2000), wherein learners select tools based on their perceived necessity instead of habitual use.

"If I'm confident in my solution, I don't need to check with AI. But when I'm unsure, that's when I use it to compare answers."

There was contention between the answers AI provided and their own. They were mostly the reasons for students rethinking their previous work as shifting from epistemic trust towards machines rather than self. This kind of reaction illustrates what Luckin et al. (2016) describe as the "automation bias," wherein a user patronizes machine-generated output even if their reasoning is right, just because it looks authoritative.

"Every time AI gives a different answer, I sometimes start to doubt my solution even if I thought it was right at first."

This normalization denotes the trend that students gradually accept the peer use of AI and blend into the social diffusion of AI learning environments, as further suggested in Rogers' (2003) Diffusion of Innovations theory.

"I wasn't surprised when I found out that most of my classmates also use AI. I think it's already common for students now."

In line with these behaviors, therefore, the use or not of AI cannot be merely reduced to the availability of tools, making it appropriate to consider the cognitive, emotional, and social environments to which the students respond. Intention to use is shaped by urgency, confidence, perceived accuracy, and peer norms, thus presenting proof that the behavioral adoption of AI is dynamic and context sensitive.

Theme 5: Actual System Use

The final theme, Actual System Use, sheds light on how students actively incorporate AI tools into their academic routines. Many participants shared that they frequently turn to AI systems—especially ChatGPT and Gemini—not just for their math subjects, but in some cases, for nearly all of their coursework.

Almost all students' exposure to AI hinges on regular usage instead of acquaintance. However, embedding it into learning environment contexts corroborates findings by Holmes et al. (2019), by which heavy use of AI results in normalization among students regarding its use routine in academics.

"I use ChatGPT almost every day in our math classes. It helps me when I cannot solve my math problem or to check if my solution is correct."

In addition, the daily use of AI tools was not applied in dire decisions, especially concerning quizzes and tests. Accessed by AI, present in learning and doing homework, students would still consciously shun it in preparation for tests, as they would prefer more traditional approaches or instructor-given materials. This is the selective usage of AI, indicating students' understanding of the limitations of AI and their critical reasoning when deciding whether to place trust in it, also referred to as "situated trust" in educational technologies by Ng et al. (2021).

"I don't rely on AI when I'm reviewing for exams. I go back to my notes and books because I want to be sure I understand everything."

Also, some students said that they are using AI for such jobs as summarizing their notes, which indicates that students are tapping into the potential of AI for performing text processing in efforts to manage and organize their academic content. These acts parallel

the progressive acceptance of generative AI into academic writing and information processing (Koehler & Mishra, 2009).

"Sometimes, I use AI to summarize my notes-it helps me remember the key points better and saves time."

None of the participants ever used AI tools as replacements for finding solutions, shortcuts, or advanced methods in mathematics. The absence of greater engagement signifies that students have not realized or tapped into the sophisticated functions of AI. According to Kay et al. (2022), student use of educational technology is typically at surface levels unless directed towards a deeper engagement and more strategic use.

"I just use it to check or explain the steps. I've never tried using AI to find a more efficient way to solve problems or new techniques."

The results indicate that AI tools have become part of the everyday academic routine of students and mostly retain their utilitarian, reactive condition. Students turn towards AI in confirmation and summary, but rarely for anything suggestive or conceptually deeper. Hence, notwithstanding this gap between potential and practice, intentionally instructed digital literacy becomes paramount, preparing students to positively leverage AI as a problem-solving tool and a learning partner.

Findings demonstrate how students of a BS in Applied Mathematics utilize multi-AI tools (ChatGPT, Gemini, Meta AI, and Cici) to infer contexts for problem-solving. These experiences are consistent with what is described in the Technology Acceptance Model (TAM), specifically regarding perceived usefulness, ease of use, and behavioral intention; however, they also extend beyond the scope of TAM. Their digital literacy practices, self-efficacy, and critical evaluation of AI-generated responses reveal new dimensions that are identifiable under the Technology-Enhanced Learning (TEL) framework. Students assert the effectiveness of artificial intelligence in generating specific and direct answers, but only by using a heavy dose of YouTube to explain concepts, especially those thick in context. These are not the primary tools but act as supplements when traditional ways fail. Such a preference for visual and auditory means reinforces the rationale of multi-learning in paths defined in Mayer's cognitive theory. Recently, ChatGPT acquired the capability to develop diagrams, albeit with limited means. Students value more multimodal assistance with mathematical illustration. Students' critical digital literacy is also underlined by checking AI outputs from several other sources before believing them, thereby showing a mindful, evaluating technology use instead of an uncritical reliance. However, there are evident tensions: frequent use of AI will, according to some students, lower motivation, promote skipping steps in problem-solving, and reduce the understanding of concepts; nevertheless,

the behavioral intention to use AI will continue to be high, given time constraints and pressure in school, with students quite virtually saying that they have to depend on it in assignment tasks with less critical stakes. Actual system use takes place regularly and is built into everyday practices, but this remains predominantly utilitarian students turn to AI primarily to check answers and summarize notes, hardly ever using it to explore deeper or alternative mathematical solutions.

Implication

These results raise important considerations for the professional development of teachers and curriculum designers, as well as the advancement of AI tools by technology developers. Teachers should encourage students to use AI tools responsibly and critically as cooperative elements alongside traditional means. Digital literacy and AI ethics education should be embedded in curricula in a manner that ensures opportunities for critical reflection and minimizes learner dependence. Developers can create AI systems that facilitate multimodal learning—incorporating text, abstraction, and interaction—to cater to students' preferences for explainability and deep conceptual understanding. Insights of this nature feed conversations in Technology-Enhanced Learning (TEL) concerning automation and human agency within educational contexts. There is a need to use AI propitiously alongside traditional teaching pedagogies without displacing them. Educators must take the lead in guiding their students on appropriately using AI rather than seeking an easy option for engaging them in more meaningful ways of learning. The evidence also reinforces the critical need for sustaining digital literacy in the curriculum so that students will learn how to evaluate AI output and lessen overdependence. Additionally, the scant exploration regarding AI's higher capabilities results in students not receiving the appropriate introduction to all its features. Digital skills training could also be included in teaching Math to move students from reactionary to active resource use. Finally, the preference toward YouTube shows that it can be beneficial for AI developers to incorporate stepwise visual comprehension features into AI systems that entirely answer learning needs.

Recommendation

Future research on AI applications in education should consider broadening the coverage of the sample of students taking part in the investigation to include students in other courses and universities. In addition, longitudinal studies can also assess moving student behaviors and perceptions concerning AI technologies as they progress. Qualitative findings can be enriched through inference and correlation by including quantitative data on their impacts on students' learning outcomes, such as academic performance or AI usage

logs. Institutions must set workshops or modules to teach students how to use such tools while critically analyzing and using the outputs productively. Further, AI tool programmers may imbue their tools with explainable and multimodal features such as voice guidance, video-style tutorials, and graphic representations to increase congruence with education. Ultimately, teachers should create a mindset that reframes AI as not replacing human learning but as a co-pilot to support problem-solving, critical thinking, and independent learning through supportive co-agents in studies.

Abbreviations

AI: Artificial intelligence; TAM: Technology Acceptance Model; TEL: Technology-Enhanced Learning; BS: Bachelor of Science; STEM: Science, Technology, Engineering, and Mathematics

Acknowledgements

The authors acknowledge the collaborative support from the BS Applied Mathematics students, their instructors, and administrators at Carlos Hilado Memorial State University during data collection and analysis.

Author's contributions

Alfredo Alave led study conceptualization, design, and manuscript drafting. Francis Jose Bearneza was responsible for data collection, interview facilitation, and qualitative coding. Both authors contributed to methodological decisions and critical manuscript review.

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Both authors are from the Mathematics Department under the College of Arts and Sciences of the Carlos Hilado Memorial State University, Philippines. Their research interests include mathematics education, educational technology, and qualitative inquiry.

Funding

This research received no external funding.

Availability of data and materials

All datasets generated and analyzed during this study are available from the corresponding author on reasonable request.

Declarations

Competing interests

The authors declare that they have no competing interests.

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Received: 5 July 2025 Accepted: 6 November 2025

Published online: 3 March 2026

References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- Arcavi, A. (2003). The role of visual representations in the learning of mathematics. *Educational Studies in Mathematics*, 52(3), 215–241. <https://doi.org/10.1023/A:1024312321077>
- Bender, E. M., Gebru, T., McMillan-Major, A., & Shmitchell, S. (2021). On the dangers of stochastic parrots: Can language models be too big? *Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency (FAccT '21)*, 610–623. <https://doi.org/10.1145/3442188.3445922>
- Biggs, J., & Tang, C. (2011). *Teaching for quality learning at university* (4th ed.). McGraw-Hill Education.

- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Buckingham, D. (2015). Defining digital literacy: What do young people need to know about digital media? *Nordicom Review*, 36(s1), 139–147. <https://doi.org/10.1515/nor-2015-0041>
- Chen, X., Zhang, Y., & Huang, R. (2020). The role of artificial intelligence in personalized learning. *Educational Technology & Society*, 23(4), 45–57.
- Clark, R. C., & Mayer, R. E. (2016). *E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning* (4th ed.). Wiley.
- Crompton, H., & Burke, D. (2023). Artificial intelligence in higher education: The state of the field. *International Journal of Educational Technology in Higher Education*, 20(22), Article 22. <https://doi.org/10.1186/s41239-023-00412-1>
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340.
- Delgado, C., & López, M. (2024). Predictors of student attitudes towards artificial intelligence: Implications and relevance to the educational process. *International Journal of Online and Distance Learning Studies*, 15(3), 234–256. <https://www.ijods.com/article/predictors-of-student-attitudes-towards-artificial-intelligence-implications-and-relevance-to-the-14758>
- Egan, K., et al. (2017). Challenges of inputting mathematics on digital devices: A usability perspective. *Journal of Educational Technology Systems*, 46(4), 464–478. <https://doi.org/10.1177/0047239516685168>
- Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning*. Center for Curriculum Redesign.
- Jones-Jang, S. M., Kim, D., & Liu, J. (2023). How do people react to AI failure? Automation bias and algorithmic aversion. *Journal of Computer-Mediated Communication*, 28(1). <https://doi.org/10.1093/jcmc/zmac029>
- Kay, R. H., Leung, S., & Tang, H. (2022). Exploring student use and perceived impact of AI-powered tools in higher education. *Educational Technology Research and Development*, 70(6), 2883–2903. <https://doi.org/10.1007/s11423-022-10127-4>
- Khan, M., & Cope, A. (2023). Cognitive effects of automation bias in AI decision-making. *Frontiers in Psychology*. <https://doi.org/10.3389/fpsyg.2023.1118723>
- Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, 9(1), 60–70.
- Liu, C., Lin, C., & Tsai, C. (2018). Analyzing students' learning behavior in an artificial intelligence-based mathematical problem-solving environment. *Computers & Education*, 126, 47–63.
- Luckin, R. (2018). *Machine learning and human intelligence: The future of education for the 21st century*. UCL Press.
- Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education*. Pearson Education.
- Marymount University. (2022). Technology enhanced learning: Why, how, and tools. <https://online.marymount.edu/blog/technology-enhanced-learning>
- Mayer, R. E. (2009). *Multimedia learning* (2nd ed.). Cambridge University Press.
- McCarthy, J. (1956). The AI approach to problem-solving. *Proceedings of the Dartmouth Conference on AI*.
- Memiş, Y. (2023). Examining the potential and pitfalls of AI in problem solving. *Journal of Pedagogical Research*, 7(1), 52–62.
- Mentimeter. (2023). What is technology enhanced learning? <https://www.mentimeter.com/blog/education/technology-enhanced-learning>
- Mustafa, M. Y., Tlili, A., Lampropoulos, G., Huang, R., Jandrić, P., Zhao, J., Salha, S., Xu, L., Panda, S., Kinshuk, & López-Pernas, S. (2024). A systematic review of literature reviews on artificial intelligence in education (AIED): A roadmap to a future research agenda. *Smart Learning Environments*, 11(59). <https://doi.org/10.1186/s40561-024-00202-7>
- Ng, W., Nicholas, H., & Williams, A. (2021). Developing students' trust in educational technology: The role of situational, cultural, and cognitive factors. *British Journal of Educational Technology*, 52(5), 1934–1948. <https://doi.org/10.1111/bjet.13110>
- Nguyen, Q. N., & Ikeda, M. (2019). Adaptive learning systems in AI education. *Journal of Educational Computing Research*, 57(2), 321–342.
- Piech, C., Sahami, M., & Guibas, L. (2015). Automated grading in large-scale education. *Journal of Learning Analytics*, 2(1), 77–89.
- Polya, G. (1957). *How to solve it: A new aspect of mathematical method* (2nd ed.). Princeton University Press.
- Rahman, M., Hossain, T., & Khan, S. (2021). AI-driven applications in mathematics education. *Educational Review*, 73(5), 620–638.
- Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.
- Russell, S., & Norvig, P. (2021). *Artificial intelligence: A modern approach* (4th ed.). Pearson.
- Scherer, R., & Teo, T. (2019). Editorial to the special section—Technology acceptance in education. *British Journal of Educational Technology*, 50(5), 2305–2308. <https://doi.org/10.1111/bjet.12866>

- Selwyn, N. (2020). *Should robots replace teachers? AI and the future of education*. Polity Press.
- Smith, R., & Johnson, P. (2021). College students' perceptions of AI-based learning tools. *Journal of Higher Education Research*, 45(3), 112–126.
- Srilatha, N., & Sen, A. K. (2024). Review of technology-enhanced learning in mathematics education. *Journal of New Approaches in Educational Research*, 15(2), 123–138.
- Subedi, D. (2021). What is saturation in qualitative research? *Open Journal of Social Sciences*, 9(7), 342–348. <https://doi.org/10.4236/jss.2021.97026>
- Van Dijk, J. (2020). *The digital divide*. Polity Press.
- Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences*, 39(2), 273–315.
- Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, 46(2), 186–204.
- Venkatesh, V. (2022). Adoption and use of AI tools: A research agenda grounded in UTAUT. *Annals of Operations Research*, 308(1), 7–41. <https://doi.org/10.1007/s10479-020-03918-9>
- Xu, X. (2025). Exploring the interrelation of family, society, and cultural influence on international Chinese and Indian STEM doctoral students in the U.S. *Journal of International Students*, 15(10), 1–26. <https://doi.org/10.32674/xjijieq83>
- Zhang, L., & Wang, H. (2022). AI in higher education: A study on student engagement with AI-driven academic resources. *Computers & Education*, 178, Article 104357.
- Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–39). Academic Press.

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