EMPOWERING WHILE LIMITING CHATGPT USE IN MATHEMATICS LEARNING: PERSPECTIVES AMONG PRESERVICE MATHEMATICS TEACHERS

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ABSTRACT: *This study explores the experiences, challenges, and suggestions of 69 preservice mathematics teachers regarding ChatGPT's use in learning mathematics. Using thematic analysis within a qualitative design, and grounded in Constructivist Learning Theory and the TPACK framework, findings revealed both empowering and limiting results. Participants valued ChatGPT's step-by-step explanations and support for independent learning, but reported issues with accuracy, depth, clarity, and advanced content. Suggestions included improving explanation quality, visual interactivity, and mathematical reliability. A conceptual model was developed, highlighting how ChatGPT can either support or hinder learning based on user cognitive and technological readiness and pedagogical fit. The study emphasizes the need for AI literacy, ethical use, and TPACK-informed training in mathematics teacher education programs.*

Keywords: AI in education, AI literacy, ChatGPT, mathematics education, serviced mathematics teachers, TPACK framework

INTRODUCTION

The growing integration of artificial intelligence (AI) in education is reshaping how students engage with content, explore concepts, and develop skills across disciplines. One of the most prominent AI tools driving this transformation is ChatGPT, a large language model capable of generating human-like responses, explanations, and feedback. In mathematics education where logical reasoning, problem-solving, and conceptual clarity are paramount, ChatGPT has been introduced as a support tool for tutoring, content creation, and interactive learning experiences. Several studies have demonstrated ChatGPT's potential to enhance student engagement, foster self-directed learning, and assist in solving complex mathematical problems [1,2]. Despite these emerging insights, most existing studies focus on in-service teachers, engineering or data science students, or general academic applications, leaving a critical gap in understanding the experiences of preservice mathematics teachers, a group poised to shape the future of classroom practice. Few studies explore the specific challenges these future educators face when using ChatGPT for learning mathematical content. Moreover, current literature tends to emphasize either the technical capabilities of AI or broad user perceptions, without critically examining how preservice teachers reflect on ChatGPT's integration into their own learning processes or how they envision its application in future teaching. While studies such as those by Egara and Mosimege (2024) and Almarashdi et al. (2023) underscore the instructional potential of ChatGPT, they often overlook the dual role preservice teachers occupy as both learners and future implementers of AI tools [3, 1]. Therefore, this study addresses the gap by examining the challenges and suggestions offered by preservice mathematics teachers regarding the use of ChatGPT as a learning support tool. It aims to provide qualitative insights of AI integration in mathematics education, particularly within teacher preparation programs. Specifically, this study aims to determine the issues and challenges encountered by the participants in using ChatGPT as an aid in learning their lessons in mathematics. Moreover, it seeks to determine the suggestions these preservice teachers may offer in order to empower the use of ChatGPT in assisting learning of mathematics lessons among preservice mathematics teachers while determining limitations in order to maximize learning in mathematics subjects. This study is anchored in Constructivist Learning Theory and the Technological Pedagogical Content Knowledge (TPACK) framework to examine ChatGPT's role in mathematics learning among preserver teachers. Constructionist theory, grounded in the works of Piaget, Vygotsky, and Bruner, emphasizes that learners actively build knowledge through exploration, interaction, and contextual engagement.

MATERIALS AND METHODS

This study employed a qualitative research design. It utilized thematic analysis to examine the issues, challenges, and suggestions shared by preservice mathematics teachers regarding their use of the Free Model ChatGPT in learning mathematics. Thematic analysis followed Braun and Clarke's (2006) six-phase framework: familiarization with the data, coding, generating initial themes, reviewing themes, defining and naming themes, and producing the report. This method was chosen to provide in-depth insights into participants' perceptions, experiences, and pedagogical reflections on the AI tool. The participants of this study were all preservice mathematics teachers enrolled in the Bachelor of Secondary Education Major in Mathematics (BSEd Math) program in the First Semester of School Year 2024-2025 at a state university. A total of 69 preservice teachers from First Year to Fourth Year were invited to share their insights through open-ended questions, with informed consent obtained from all participants. These participants were taking one to five different mathematics subjects as their major of specializations during the conduct of the study. The higher the year level, the more challenging the mathematics subjects become, in both mathematical content and pedagogical knowledge. Although names were requested, all responses were treated with strict confidentiality, and no identifying information was revealed, ensuring complete anonymity of participants throughout the study. Participant responses were collected via Google Forms and organized in a Google Sheet for analysis. Each response to the open-ended questions was

carefully read and re-read to ensure thorough familiarization with the data. Initial codes were generated to identify recurring words, phrases, and ideas. These codes were then grouped into categories based on thematic similarity. Categories were refined, retained, merged, or redefined, as the analysis progressed, eventually forming the core themes of the study. Themes were reviewed to ensure internal coherence and distinction from one another, and each theme was then clearly described to capture its essential meaning. The open-ended questions are as follows: *What is the frequency of you using ChatGPT in learning mathematics lessons? Have you ever encountered any issues or misunderstanding while using ChatGPT for learning mathematics? What were the issues or misunderstandings that you have encountered while using ChatGPT for learning mathematics? Please specify the challenges or limitations that you have encountered while using ChatGPT in learning your mathematics lessons. What are your suggestions pertaining to the improvement of ChatGPT's features towards effective learning in mathematics? What are your suggestions pertaining to how ChatGPT can be used by teachers and students in their classroom for a better learning experience? Do you have any additional comments pertaining to the use of ChatGPT in learning mathematics?* These research questions were validated by three experts and piloted to preservice mathematics teachers at a different campus of the same state university. Participant insights under each theme were also incorporated into the discussion to provide depth and context to the findings. The study followed ethical research protocols, including obtaining informed consent, ensuring voluntary participation, and maintaining confidentiality.

RESULTS

Building on Batucan, et. al. (2025), who noted preservice teachers' use of ChatGPT for problem-solving and clarifications [4], this study reveals their challenges and need for stronger support in mathematics learning. These insights are vital for refining use of AI tools to complement traditional teaching and enhance mathematics education.

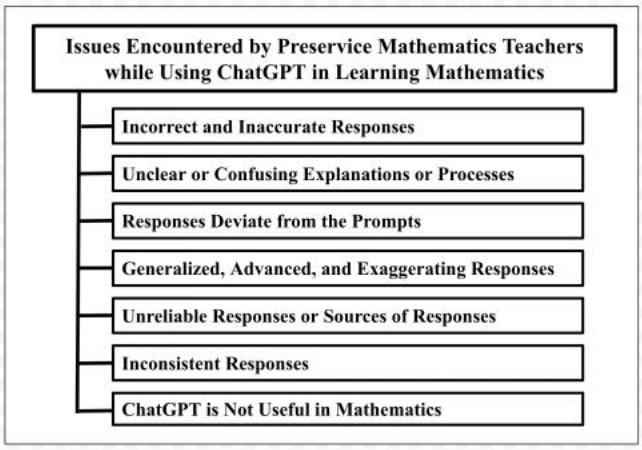

Figure 1. **Issues Encountered by the Preservice Mathematics Teachers While Using ChatGPT in Learning Mathematics**
Source: **Author's own work**

Figure 1 presents seven emerging themes from participants' insights on issues with using ChatGPT in learning mathematics, followed by a structured discussion of their feedback.

1. Incorrect and Inaccurate Responses. Participants noted that ChatGPT often provides wrong answers, uses inappropriate formulas, or fails in computation, especially when problems are complex. Responses show frustration with the factual incorrectness in solutions, such as:

"Mistakes from providing the right answer/explanation."
"ChatGPT sometimes gives wrong answers, it uses another or wrong formula."
"The harder the problem or question, the more the AI makes a mistake."
"Mistakes in computation."
"Sometimes the answer is far from the correct answer."
"...sometimes give wrong figure explanations."
"... not giving you the correct answer but rather an idea of what should be done."
"Incorrect answer, information, and data."
"Wrong answer/solution when I double check the answers."
"... made some errors in providing the answer which I could confirm when I double checked it using my calculator."
"Sometimes they give wrong answers, especially in solving numbers with decimal answers."
"There are mathematical problems that ChatGPT can't provide the correct solution."
"ChatGPT is not hundred percent true, it depends on how simple or complex the equations are…"

ChatGPT's errors stem from its probabilistic design, generating pattern-based rather than formally reasoned answers. In mathematics, this leads to inaccuracies that erode trust.

Moreover, Inaccurate Responses points to partial correctness or superficial accuracy, where answers appear plausible but fail in depth, precision, or detail:

"The answers are not accurate sometimes."
"It doesn't give accurate answers and solutions."
'It directly gives the answer rather than showing the steps which in turn dissolve the purpose of using it."
"It doesn't provide accurate answers especially in proving."
"Sometimes the answers are not accurate, especially in solving mathematical equations."
"Sometimes the answers are lacking which makes it more difficult to understand."
"..tend to provide inaccurate answers especially when the mathematical concepts are too complex especially in proving…"

2. Unclear/Confusing Explanations/Processes. The participants found some responses poorly explained, misleading, and hard to follow, particularly when involving step-by-step processes:

"Not appropriately explained."
"... misleading step by step processes…"
"Not clear."
"It provides misleading answers that often lead to confusion…"
"In proving triangles, circles and parallel lines because the explanation and order of proofs are confusing…."
"...solve problems that are difficult to understand."
"...it can give you a far out proof, making it hard to understand…"
"Confusion of their answers on the specific problem/concepts you ask."
"... sometimes give different answers and explanations that can cause confusion."

3. Responses Deviate from the Prompts. The participants observed that ChatGPT sometimes provides answers that are off-topic or not aligned with the question, indicating misinterpretation of prompts:

"There are far answers to my questions sometimes."
"There are times … responding to something like not related to the questions I gave."
"... it gives you a response that is kind of not what the answer that you want."
"... can't understand the instructions I relay…"

"It usually misunderstands the concept of what is being asked."
"The answers are not accurately connected to the questions/problems."
"There are instances when they might provide different answers if the equations are not specified correctly."

4. Generalized, Advanced, or Exaggerated Responses. Some participants noted responses that were either too broad, too technical, or contained unnecessary elaborations:

"Some advanced explanation that is not related to the question."
"Providing step by step answers but … some exaggerated answers."
"... has its own format that is sometimes confusing."
"Sometimes the topic was too broad and I cannot understand it easily."

5. Unreliable Responses or Sources. Concerns were raised over source of credibility and the trustworthiness of information:

"Not reliable resources."
"It doesn't provide real or true sources of information or it is an unreliable source of information."
"... I can't be assured that the answer they gave was right…"

6. Inconsistent Responses. Some users found that ChatGPT gives different answers to similar questions:

"It will give you different answers when you ask the same questions."
"... when I asked similar questions, it gave different answers compared to the previous one."
"... the answers it provides are inconsistent sometimes."

7. Perceived as Not Useful in Mathematics. This theme concluded that ChatGPT may not be useful or beneficial for math learning:

"...it's not really useful in learning mathematics."

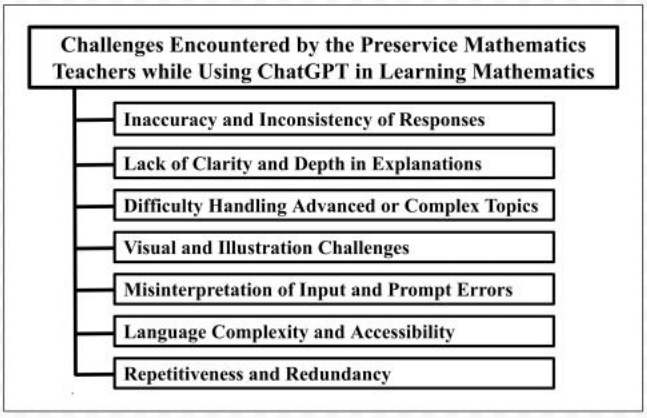

Figure 2. **Challenges Encountered by the Preservice Mathematics Teachers While Using ChatGPT in Learning Mathematics *Source:* Author's own work**

To reinforce Figure 1, Figure 2 shows themes on challenges preservice teachers faced in learning mathematics with ChatGPT.

Inaccuracy and Inconsistency remained dominant, as incorrect and unstable answers undermined trust.

Lack of Clarity and Depth showed dissatisfaction with vague, generalized, or incomplete explanations, revealing a need for step-by-step logic and conceptual clarity.

Difficulty with Advanced Topics reflected ChatGPT's limits in handling higher-order tasks like proofs, integration, and reasoning.

Visual and Illustration Challenges emphasized the absence of diagrams or graphs, which hindered comprehension, especially for visual learners.

Misinterpretation of Inputs revealed errors when prompts were ambiguous or symbolic, stressing the need for precise formulation.

Language Complexity emphasized accessibility issues, as overly technical English and jargon obscured meaning for some learners.

Repetitiveness and Redundancy, though minor, caused frustration when content was repeated unnecessarily.

These themes show the need for clearer, more reliable, and accessible AI support in mathematics teaching.

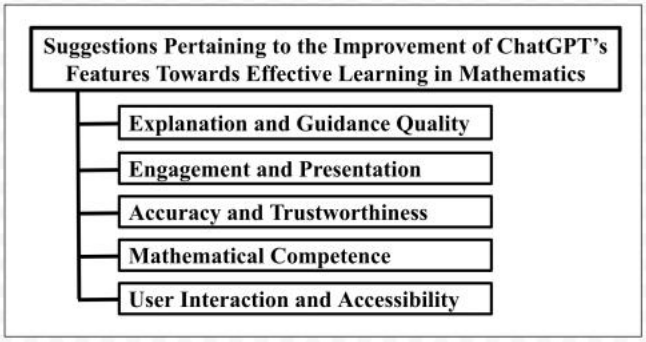

Figure 3. **Suggestions Pertaining to the Improvement of ChatGPT's Features Towards Effective Learning in Mathematics**
Source: **Author's own work**

Figure 3 presents the emerging themes based on participant insights, identifying suggestions pertaining to the improvement of ChatGPT's features towards effective learning in mathematics.

1. Explanation and Guidance Quality - This dominant theme reflects the participants' need for clear, precise, and structured explanations with step-by-step solutions, especially in geometry and proofs. They valued organized, logical sequencing, viewing ChatGPT as a tutor that must communicate solutions effectively.

"More understandable and precise (have an explanation to each problem or make it easy to understand…"
"To explain deeper about some complicated mathematical concepts and problems."
"...understandable explanations."
"Providing precise solutions."
"Well-explained topics."
"Make information specific…"
"Make expanded explanations in solutions and more proof…"
"Clear."
"It can give more advanced explanations for proofs."
"...correct sequence in proving."
"Give exact instructions in making diagrams of geometrical statements."
"A step-by-step solution with corresponding explanation."
"...no limits in giving detailed discussions… provide comprehensive proofs…"
"...explanations… that are longer…"
"...step-by-step solutions…clear, concise explanations"
"...more examples given and not too broad."
"...the answer must be straight to the point."
"To provide more options or clearer explanation in solving problems."
"Complete solutions."

2. Engagement and Presentation - Participants emphasized the need for visuals, real-world examples, and interactive tools to make concepts clearer and more engaging, along with personalized, flexible responses for diverse learning styles.

"Video presentation."
"Relevant response…"
"...give different ways to solve the problem…"
"...may be able to generate a much more accurate illustration of the given instruction…"
"To provide illustration."
"Examples showing how mathematics apply to real-world scenarios to

make learning more relatable and interesting."

"...picture and illustration…help students… understand description… such as word problems and illustrations in geometry…"

"...can provide an accurate graphical presentation…"

"Can make a figure."

"Provides pictures or graphs."

"Graphing and visualization."

"...figures should be connected and correctly constructed."

"More personalized and have a well-dynamic understanding of the prompts."

"Provide graphs or images."

"...visual aids…"

3. Accuracy and Trustworthiness - Participants stressed the need for reliable, up-to-date solutions with credible references, highlighting concerns about factual integrity in academic settings.

"...reliable explanations."

"ChatGPT should give reliable resources…"

"Accurate…"

"ChatGPT should include references or citations for students to explore and understand more…"

"More accurate explanations."

"...get its information from reliable sources"

"Updated information about mathematical concepts."

"Accurate solving and proving."

4. Mathematical Competence - Participants called for stronger problem-solving skills, better handling of symbols, and accurate proofs, suggesting a need for a model that is mathematically intelligent, not just linguistic.

"...focus on stem and engineering related topics and is specifically designed to solve hard maths…"

"...have a feature wherein some formulas or symbols in mathematics are in there."

"There should be a section… intended only for mathematical problems."

"To solve complex math."

"...solving complex mathematical problems that will not misrepresent the original problem and present solutions that do not align with the given problem."

"...more effective in proving geometry."

"...more advanced in proving geometry…"

"...varied problem-solving approaches…"

"The ability to provide graphs and better handling of complex equations."

5. User Interaction and Accessibility - Participants emphasized affordability, ease of use, and inclusive access through simpler formats and personalized learning paths.

"...improve its mathematical ability and skills to understand what is given."

"Cheaper models…"

"Considerate."

"Free access."

"...free pro account."

"...personalized learning paths…"

"...provide an easier format…"

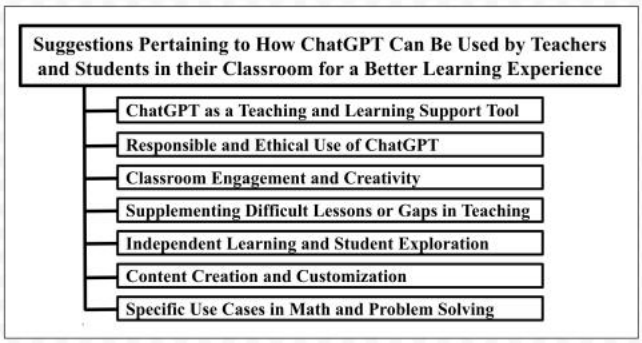

Figure 4. **Suggestions Pertaining to How ChatGPT Can Be Used By Teachers and Students in their Classroom for a Better Learning Experience (n = 56)**

Source: **Author's own work**

Figure 4 presents the suggestions of the participants pertaining to how ChatGPT can be used by teachers and students in their classroom for a better learning experience.

1. ChatGPT as a Teaching and Learning Support Tool - Seen as a tutor and explainer, ChatGPT helps clarify topics, provide step-by-step solutions, generate exercises, and support lesson planning, serving as a complementary aid when resources are limited.

"ChatGPT should be used by teachers and students for better understanding the topic"

"By providing accurate answers"

"for more understandable learning"

"teachers may use ChatGPT to generate examples and further explanations about the lesson "

"provide accurate examples "

"Teachers can utilize it for personalized learning materials (exercises, quizzes, explanations, lesson plans, presentations), identifying areas for improvement in teaching. .."

"Quick reviewers and practice problems."

"Expand the topic "

"ChatGPT can be used by teachers and students for helping to articulate more of their thoughts/ideas in a more formal way. .."

"ChatGPT can be utilized by teachers and students as an aid for learning, it can be a learning or teaching tool."

"ChatGPT can be used by helping the students and teachers to understand more on the mathematical concepts."

"I think ChatGPT could be used by both teachers and students as a tool that would make long texts such as in history books …"

"Chatgpt can be used to have a better learning experience by teachers and students by extracting the ideas provided by ChatGPT in any tasks or assignments. …"

"Teachers and students can use ChatGPT in verifying answers to a certain question…"

"Checking the thoughts, the grammar, checking the solutions if they are the same as yours or on the answer key. .."

"I suggest that for getting any idea on reports i recommend chatgpt for having the good explanation of the idea but i do not recommend for mathematical solutions because sometimes ChatGPT may give other outcome"

"For explanations and discussions "

"Chatgpt may provide insights that can help teachers broaden their knowledge and make it a guide for the teaching process."

"I can only say that the ChatGPT is only for guidance in every discussion or any form of classes that need an explanation, so that the students will know the reasons behind."

"ChatGPT can be used by teachers to provide personalized tutoring, …"

2. Responsible and Ethical Use of ChatGPT - Participants stressed guided, moderated use with accuracy checks, avoiding over-reliance, and treating ChatGPT as a support tool rather than a substitute for teachers.

"...use ChatGPT in moderation…"

"...don't fully depend on what the ChatGPT gives you"

"...But again, do not consider them directly, prior knowledge must be applied to filter the information from AI"

"... However, teachers must emphasize accuracy verification, ethical use, and the irreplaceable role of human interaction in education."

"Using it cautiously since AI won't provide exact information or sometimes lacks concepts."

"... Teachers and students should also check the contents from chatGPT before using it."

"It should be used only before or after class "

" It can help students to understand more the concept of a certain activity."

"...the teachers must have a strong AI detection tool, in order to ensure that students do not solely rely on ChatGPT answers."

"Better to use ChatGPT as a reference after doing task than during and before the task"

"ChatGPT can be used by teachers and students in their classroom for a better learning experience by utilizing it to assure that the answers of the students were correct…"

"Use it only as a guide or for some clarifications."

"...in a good way and it must also have limitations on when to access it. "

"Teacher/s should now have boundaries on proper usage of ChatGPT to ensure that students will not be more dependent on it. It should have to be with proper guidance. "

"Use only to seek mathematical definitions."

3. Classroom Engagement and Creativity - Participants viewed ChatGPT as a catalyst for interactive exercises, real-world applications, and creative activities that spark discussion and student-centered learning.

"Make it as a tool for engaging class "

"AI models like ChatGPT have to be trained on classroom integration like the environment."

"For me, while chatgpt sometimes fails to satisfy its users, it still has the capacity to help in the area of the teacher-student interactions like when it is really that urgent to access information in the classroom, then ChatGPT or other AI applications can still go…"

"ChatGpt could be used in learning in a way in which teachers and students will use it as a guide for them to … be more creative."

"... Classroom applications include interactive quizzes, stimulating debates, and creative writing exercises…."

"Generate custom flashcards for key terms, formulas, or historical events to enhance memorization and support study habits."

"Chat GPT can be used by teachers and students to make the lessons more engaging…"

"...It can help to build more engaging activities as they can provides a lot engaging activities "

"Chatgpt can be used by teachers and students in their classroom for a better learning experience through meaningful discussions. This will help the students and teachers identify how accurate the information is and make the topic understand easily through making it concise and concrete."

"...and for both parties to have a more engaging, active, and well-rounded discussion. "

"I think this could be useful in classroom activities, maybe in group discussion or group activities. "

"Having ChatGPT can give you an idea of what motivational activity you would do for your topic."

4. Supplementing Difficult Lessons or Gaps in Teaching - Participants saw ChatGPT as a backup resource for clarifying difficult or incomplete lessons, supporting differentiated learning and deeper understanding.

"...understanding more examples for certain topics"

"...se it as a support of your own understanding in order for you to enlighten the lesson that is giving you a hard time…"

"As a Teacher, we are given a topic that could be discussed in front of our class and there are more terms and words that are difficult to understand. The best tool to use is the Ai as it gives an understandable explanation of the words you asked…"

"I suggest that ChatGpt should be used if there's a topic or certain questions that cannot be answered directly"

"...as a tool to make the text more understandable because sometimes the used words are unfamiliar. …"

"...and easy to understand because chat gpt can provide explanations that are easy to grasp"

"ChatGPT can help us to realize what are the knowledge gaps that we've missed in the terms of analyzing the concept. "

"...they can use it to look for other alternative ways as to how to solve mathematical problems in a convenient way. "

"Maybe for clarification and explanation for the topics that is very difficult to understand "

"If you have any questions that we can't answer, let's ask ChatGPT."

"ChatGPT can help in clarifying doubts and gives explanations for mathematical concepts."

"It can be used when certain topics are very complex and ChatGPT can simplify those topics to fully understand by the student"

5. Independent Learning and Student Exploration - Participants opined ChatGPT's role in fostering autonomy, self-regulated learning, and individual growth as a learner-driven companion.

"In some situations that a teacher could not be able to thoroughly explain a certain topic, he or she could at least refer to any ventures online (ChatGPT) to at least be able to gather more information and possibly, can explain and be able to interpret the lesson comprehensively."

"Students may use ChatGPT as an AI tutor when having problems understanding the lesson, to generate exercises, and assess their mathematical knowledge or skills, or maybe ask about what specific areas need improvement."

"...Students benefit from personalized tutoring, writing assistance, language learning practice, and exploration of new topics…"

"...As a Student, you can encounter lessons that are new to you and you are not familiar with the terms, uses etc. To be able to understand more you can search on Google or ask the Ai to explain the lesson and for you to completely understand and comprehend the lesson. "

"...Can serve as a guide sometimes in other aspects since today's 21st-century is more on independent learning so students must know how to explore to have a better learning experience. "

"...while students can use it to clarify concepts, practice problem-solving, and get immediate feedback."

"Since we live in a modern world, I suggest that teachers allow students to explore ChatGPT more when they want to widen their knowledge"

6. Content Creation and Customization - Participants saw ChatGPT as a tool for generating assessments, lesson plans, presentations, and summaries, enhancing productivity and tailoring learning materials.

"ChatGpt could be used in learning in a way in which teachers and students will use it as a guide for them to create an idea…".

"Teachers can use ChatGPT or any ai tools in making assessment questions and for the students they can use ai to gain some ideas and information "

"For me it can help teachers and students in summarizing a certain subject or activities …"

"It can be used for making a PowerPoint presentation."

"Teachers and students can utilize ChatGPT to enhance learning through personalized lesson plans, interactive simulations, automated grading, real-time feedback, language translation and other innovative educational tools."

"In collaborative learning, especially on tasks that are way too hard or complicated, the teachers must allow the student to use ChatGPT …"

"...generate practice problems, and assist with lesson planning, …"

7. Specific Use Cases in Math and Problem Solving - Participants stressed ChatGPT's role in solving and verifying problems, simplifying difficult topics, and generating relatable examples for STEM learning.

"Can be used for solving…"

"I guess it should improve its mathematical skills."

"ChatGpt will be used for further explanation and some mathematical problems."

"…ChatGPT could also be used as a tool to make examples (real life) that could make the students relate it into their lives."

"The teachers should allow students to use ChatGPT , because sometimes some topics are not understable especially in math.

ChatGPT allows students to research it easily in ChatGPT and they can read and have an idea on how to solve a math problem. ChatGPT provides step by step solutions. "

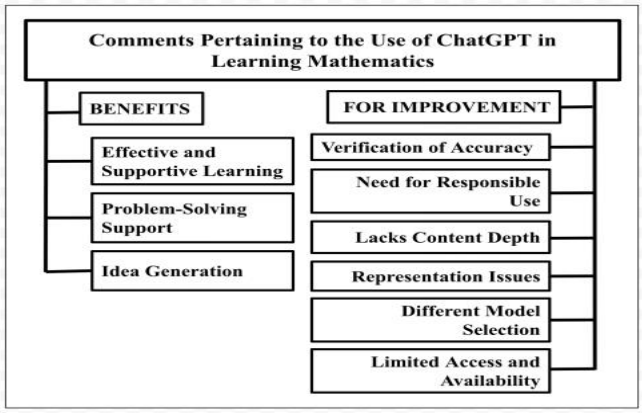

Table 5. **Additional Comments Pertaining to the Use of ChatGPT in Learning Mathematics**
Source: **Author's own** work

Figure 5 shows themes from participants' additional comments on ChatGPT in learning mathematics, noting both benefits and areas for improvement.

Benefits of ChatGPT Use in Learning Mathematics:

1. Effective and Supportive Learning **-** Participants valued ChatGPT as a confidence-building, concept-reinforcing, step-by-step tutor. Seen as a tireless companion for independent study, it supports but does not replace teachers.

"ChatGPT has made my learning more effective."

"ChatGPT's been a huge help in math. It patiently explains concepts and walks me through problems step-by-step, offering different approaches until I understand. It's like having a tireless tutor, breaking down complex ideas into manageable pieces. While it's not a replacement for a teacher, it's significantly improved my problem-solving skills and confidence. I still need to do the work, but it makes learning much more efficient."

"Not much. But if you feel lacking in a particular lesson on mathematics it isn't always bad to have a helping hand. '

"ChatGPT may sometimes provide explanations for answers far from the answer you're looking for but overall ChatGPT is very useful. Especially to those students who study alone. "

"We suggest ChatGPT for providing us an idea but not totally copying the whole idea because somehow, it is not always accurate."

"ChatGPT is a life-changing tool that can contribute a lot when used in an appropriate manner particularly in the mathematics field."

"Using it removes doubts in your own solutions."

"ChatGPT is very helpful, because they give ideas and answers to all our math problems. All we need to do is to read it and understand it."

"Using ChatGpt in learning mathematics has somewhat a great help for me as it helps to provide details about certain mathematicians"

2. Problem-Solving Support **-** Participants found ChatGPT helpful for basic and word problems by simplifying concepts but noted limited clarity and depth in advanced problem-solving.

"If searching basic steps in mathematics the answers could be accurate, but if you're searching on a more complex problem the AI wasn't reliable on its answers."

"Sometimes the step by step process are short cut not in detailed explanation "

"Chat gpt is effective to use in solving word problems "

"ChatGPT helps in breaking down complex mathematical concepts into simpler explanations, making learning more accessible."

3. Idea Generation **-** Even with errors, participants valued ChatGPT for sparking ideas and providing starting points, though not as a sole source of answers.

"Chatgpt can give you a guide despite giving wrong answers, which is very useful for you to be guided and can easily do what's next."

"In terms of Geometry the tool is not that accurate though you could have an idea from the tools answers. In Algebra it's not that accurate, same with Trigonometry I still prefer to ask from the teacher and do more research on Youtube."

"Using ChatGPT may be useful when it comes giving idea but we must not rely on ChatGPT's solution in mathematics because it has a possibility it's not accurate and have some confusion"

Areas Needing Improvement of ChatGPT Use in Learning Mathematics:

1. Verification of Accuracy **-** Participants stressed cross-checking ChatGPT's answers, cautioning against blind reliance given its limits in mathematical precision.

"The use of ChatGPT must be regulated by the users, while it answers to our questions immediately, users must not consider them directly. It must be checked through other information we access from different links."

"Make sure to check the answer before believing that it is the real answer. Be sure of everything."

"Users should double check the answers provided by ChatGPT. "

2. Responsible Use **-** Participants urged responsible AI use, warning against full reliance and stressing active student engagement with content.

"Do not always rely on ai tool"

"Do not rely in AI's"

"Review the answers."

3. Lacks Content Depth **-** Participants noted ChatGPT's limited depth, especially in areas like the History of Mathematics, where richer insights are needed.

"For example in History of Mathematics, the details of some Mathematicians are only short and common descriptions that are well known for his contributions. Not the uncommon information that we need to learn from him/her."

4. Representation Issues **-** Some participants found ChatGPT's symbols or notations inconsistent with classroom standards, causing confusion.

"I don't like the symbols they use as a representation of something."

5. Different Model Selection - Participants noted that performance varies across ChatGPT versions, with newer models giving better results.

"Choose o1 models for best results."

6. Limited Access and Availability **-** Participants noted that subscription or technical barriers limit consistent use of ChatGPT for learning support.

"It has limited access "

DISCUSSIONS

Issues Encountered. Preservice mathematics teachers reported ChatGPT's inaccuracies, often from outdated data, approximate logic, or oversimplified proofs. Getenet (2024) and Callingham & Jong (2024) noted solutions that appeared correct but were flawed, with reasoning that was sometimes unclear [5,6]. Prompt ambiguity further reduced accuracy, while fabricated references undermined reliability [7]. Responses were inconsistent, and vague or overly technical explanations limited instructional value. Kalenda et al. (2024) found initial trust gave way to skepticism as teachers identified factual errors and pedagogical misalignment [8]. From a constructivist lens, shallow outputs hindered understanding, while the TPACK framework stressed the need for AI literacy and guided integration.

Challenges. Main concerns were inaccuracy, inconsistency, vague or shallow reasoning, and difficulties with advanced topics like proofs and integration [9]. Explanations often lacked visuals, while misinterpreted prompts highlighted gaps in digital literacy [10]. Other issues included complex language [11], repetitiveness, lack of feedback, and hallucinations [12]. These align with Batucan et al. (2025), who emphasized flawed computations and unclear reasoning as barriers to meaningful learning.

Suggestions for Improvement. Preservice teachers called for clearer, more accurate, and structured explanations, with visuals, step-by-step reasoning, and simpler language [5,13]. Improved accuracy in advanced topics, personalized feedback, and ethical safeguards were emphasized [14]. These align with Constructivism, advocating guided discovery and multi-sensory learning, and with TPACK, highlighting needs across TCK, TPK, and TK.

Classroom Use. ChatGPT was seen as a versatile support tool, for tutoring, clarifying concepts, generating examples, and lesson planning, when used ethically and with oversight [14,15]. Teachers stressed balancing engagement, independent learning, and creativity with critical evaluation and AI literacy [16].

Additional Insights. ChatGPT was praised as a "tireless tutor" that builds confidence and aids problem-solving [17], but concerns about factual errors, limited depth, and symbolic representation [18] remain. Effective integration requires oversight, ethical use, and scaffolding. Constructivism and TPACK highlight ChatGPT's potential as a supplemental, not standalone, resource to enhance preservice mathematics education.

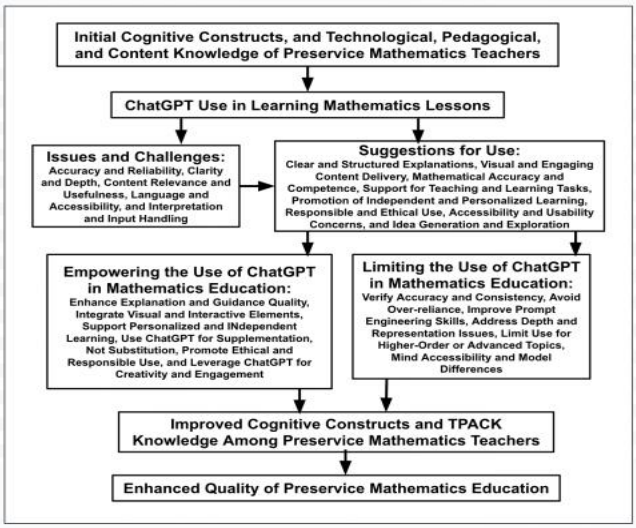

Figure 6. **Conceptual Model on Enhancing ChatGPT for Effective Mathematics Learning**
Source: **Author's own work**

The conceptual framework in Figure 6 illustrates ChatGPT's role in preservice mathematics teachers' learning, emphasizing both empowering and limiting aspects.

1. ***Starting Point - Foundational Knowledge.*** The model begins with teachers' initial cognitive constructs and TPACK, reflecting their readiness to integrate technology.
2. ***Central Focus - ChatGPT Use.*** ChatGPT serves as a mediating tool, connecting prior knowledge to both benefits and challenges in practice.
3. ***Challenges and Suggestions.*** Issues include inaccuracies, unclear reasoning, and language barriers, while suggestions stress structured explanations, engaging content, accuracy, and ethical use.
4. ***Dual Outcomes.*** Empowering uses involve improved explanations, visuals, independence, and creativity, while limiting uses emphasize verifying accuracy, avoiding over-reliance, and recognizing limitations in advanced topics.
5. ***Eng Goals.*** Both pathways lead to enhanced cognitive constructs, stronger TPACK, and improved quality of preservice mathematics education.

The framework has shown ChatGPT as both a powerful support and a potential pitfall, requiring balanced, intentional integration to maximize learning and instructional quality.

CONCLUSION

Grounded in Constructivist Learning Theory and the TPACK framework, findings showed ChatGPT's value as a "tireless tutor" offering accessibility, step-by-step guidance, and idea generation. However, issues such as inaccuracies, vague explanations, weak support for complex topics, prompt misinterpretation, and limited access reduced its reliability. Teachers emphasized responsible use, accuracy, engagement, and classroom integration, positioning ChatGPT as a supportive, and not substitutive tool.

Recommendations include:

AI Literacy Programs. Train preservice teachers in AI use, prompt design, and response evaluation.

Constructivist Use. Use ChatGPT as a scaffold for exploration and reflection, not rote answers.

TPACK-Aligned Integration. Model integration across content, pedagogy, and technology.

Ethical Guidelines. Establish policies on responsible, transparent, and moderated AI use.

Math-Specific Improvements. Enhance reasoning, visuals, symbolic interpretation, and advanced topic handling.

Accessibility and Equity. Provide equitable, multilingual, and subsidized access.

Further Research. Study long-term impacts of AI on teacher training and classroom practices.

ChatGPT is not a cure-all but shows strong potential as a learning support tool when used critically, ethically, and pedagogically. Preparing future educators to integrate AI meaningfully is vital to building reflective, innovative, and AI-ready mathematics classrooms.

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