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Exploring Pre-service Mathematics Teachers' Reflections in Lesson Planning with Generative Artificial Intelligence

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Abstract. Generative artificial intelligence (GenAI) holds transformative potential for education, yet its integration by pre-service mathematics teachers in resource-constrained contexts, such as the Philippines, remains underexplored. This qualitative study investigates 30 first-year pre-service mathematics teachers' reflections on their use of GenAI tools (ChatGPT-4, Gemini 2.5 Flash, and Perplexity AI) for lesson planning. Guided by Schön's (1983) reflective practice framework, it addresses: (1) How do pre-service teachers engage in reflection-in-action during GenAI use? (2) What insights emerge from reflection-on-action after completing AI-assisted lesson plans? Reflexive Thematic Analysis of data from individual written reflections, group observation logs, and final drafts of lesson plans revealed five themes: streamlining planning and stimulating creativity; fostering comparative tool literacy in GenAI integration; emphasizing prompt precision and instructional clarity; negotiating AI outputs via pedagogical judgment; and developing confidence as novice lesson designers. While GenAI enhances efficiency and innovation, participants stressed the need for human oversight to ensure curricular alignment, accurate and factual information, and ethical practice. Findings highlight the need for teacher education programs to incorporate training in prompt engineering, critical AI evaluation, and ethical reflection, equipping pre-service teachers for responsible GenAI use. Additionally, the study advocates for AI policy development to guide pre-service teachers in integrating GenAI into evolving educational landscapes.

Keywords: generative artificial intelligence; pre-service mathematics teachers; lesson planning; reflective practice; human oversight

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1. Introduction

Effective lesson planning serves as a foundation for quality teaching, enabling educators to design meaningful instruction that fosters student learning and engagement (Valdez et al., 2024). However, pre-service teachers often face significant challenges in developing lesson plans that meet established standards (Cevikbas et al., 2024). These challenges are particularly pronounced in resource-constrained contexts such as the Philippines, where pre-service teachers struggle to translate curriculum standards into practical lesson plans while also differentiating instruction for multigrade classrooms (Bongala et al., 2020).

The integration of technology with pedagogy further complicates this process, especially when contextual knowledge and resources are limited (Cengiz & Kaçar, 2024). In the Philippine setting, heavy workloads and insufficient interdisciplinary materials intensify these difficulties, leading some educators to question the practicality of lesson planning in real classroom environments (Alrwaished, 2024; Valdez et al., 2024).

Generative artificial intelligence (GenAI) presents promising solutions to these challenges. Tools such as ChatGPT (GPT-4), Gemini (2.5 Flash), and Perplexity AI can generate lesson plans, learning activities, and assessments tailored to diverse learner needs (Gupta, 2024; Kılıç, 2024). Research suggests that these tools have the potential to reduce teacher workload while enhancing instructional quality (Nugroho et al., 2024; Powell & Courchesne, 2024). However, effective GenAI integration requires more than mere technical proficiency. It also demands reflective pedagogical practices that allow teachers to critically evaluate and adapt AI-generated outputs to their specific instructional contexts (Sari et al., 2021).

Although prior studies have highlighted the efficiency gains of GenAI in educational settings (Antonio et al., 2024; Gurl et al., 2024), they have primarily focused on Western contexts or single AI tools. Therefore, a significant gap remains with regard to understanding how pre-service mathematics teachers in resource-constrained settings—such as the Philippines—reflect on their use of multiple GenAI tools for lesson planning. Additionally, barriers such as limited awareness and accessibility issues further emphasize the need for localized research in this area (Ramos et al., 2024).

This study addresses three critical gaps in the existing literature. First, it explores reflective practices in GenAI use within a non-Western, resource-constrained context. Second, it provides a comparative analysis of the ways in which pre-service teachers engage with multiple GenAI tools. Third, it examines both the ethical and pedagogical considerations that arise when integrating AI into lesson planning. Guided by Schön's (1983) framework of reflection-in-action and reflection-on-action, this study investigates the following research questions:

1. How do pre-service mathematics teachers engage in reflection-in-action when using GenAI tools during lesson planning?
2. What insights emerge through reflection-on-action after completing AI-assisted lesson plans?

By adopting qualitative methodology and Reflexive Thematic Analysis (RTA), this research analyzes participants' reflections on their use of GenAI in lesson planning. The findings offer implications for curriculum design, teaching practice, and educational policy in resource-constrained educational settings.

2. Literature Review

2.1 Challenges in Lesson Planning

Lesson planning is fundamental to effective teaching, ensuring alignment between instructional objectives, activities, and assessments (Sehweil, 2022; Savage, 2014). In the Philippines, the Department of Education mandates lesson planning for all competencies (Pramoolsook & Magday, 2019), yet pre-service teachers face persistent challenges. These include translating curriculum standards into actionable plans (Pham et al., 2023), administrative burdens, and evolving curricular demands, which collectively reduce confidence and raise questions about the practicality of lesson planning (Akmal et al., 2022; Valdez et al., 2024).

In the Philippine context, challenges are exacerbated by multigrade classrooms, in which teachers must differentiate instruction across grade levels (Bongala et al., 2020). While international studies have emphasized structural and administrative barriers (Cevikbas et al., 2024), local research underscores contextual pressures, such as limited resources and heavy workloads. As a mathematics educator working with pre-service teachers, I have witnessed how lesson planning often becomes a procedural task rather than a reflective one. Many preservice teachers struggle to translate abstract competencies into meaningful, context-sensitive ones—especially when faced with limited instructional materials and time constraints. Therefore, this study extends the discourse by exploring whether AI-supported lesson planning, coupled with reflective practice, can alleviate these burdens—a perspective not yet fully investigated.

2.2 Generative Artificial Intelligence in Education

Due to its ability to produce human-like content, including text, images, and assessments, the recent emergence of generative AI (GenAI) has introduced transformative possibilities for lesson design (Gupta, 2024; Siiman, 2024). Tools such as ChatGPT (GPT-4), Gemini (2.5 Flash), and Perplexity AI offer distinct affordances: ChatGPT excels in text generation; Gemini integrates real-time data for accuracy; and Perplexity AI provides transparent sourcing (Jain, 2024; Shukla et al., 2024). Studies demonstrate that educators use GenAI to draft lesson plans, generate activities, and create assessments aligned with curricular standards (Nugroho et al., 2024; Powell & Courchesne, 2024), highlighting its potential to reduce preparation time and enhance instructional quality (Ramos et al., 2024).

As a mathematics educator, I perceive GenAI not merely as a technical tool but as a collaborative partner in pedagogical design. In mentoring pre-service teachers, I have observed how GenAI can scaffold instructional creativity—particularly in generating problem-solving tasks, contextualized examples, and differentiated assessments. However, its outputs must be critically mediated. Mathematics educators must evaluate AI-generated content for conceptual rigor, curricular

alignment, and cultural relevance. This reflective engagement is especially vital in contexts where learners' mathematical thinking is shaped by local practices and linguistic diversity. Schön's (1983) reflective practitioner model offers a useful lens here, emphasizing the teacher's role in adapting and recontextualizing AI outputs to honor diverse epistemologies and learner needs.

Nevertheless, GenAI integration introduces a range of complexities. Its effective use depends on prompt engineering (Knoth et al., 2024; Yanar & Ergene, 2025), while inherent risks such as hallucinations, bias, and over-reliance on AI necessitate critical oversight (Aljamaan et al., 2024; Kasneci et al., 2023). In contrast to earlier digital tools, GenAI's autonomy in generating content—rather than merely delivering information—renders teacher judgment and reflection more critical than ever. Yet, to date there remains a dearth of literature addressing the ways in which pre-service teachers exercise pedagogical agency in adapting AI outputs, particularly in resource-constrained settings.

2.3 Reflective Practice

Schön's (1983) framework of reflection-in-action (whereby teachers make real-time adjustments to lessons as a result of formative assessment) and reflection-on-action (retrospective insights to inform future lesson planning) remains foundational in teacher development. Research links reflective engagement to adaptability, resilience, and the formation of professional identity (Asfeld & Stonehouse, 2021; Ayoobiyan & Rashidi, 2021; Diseth, 2025; Neokleous & Krulatz, 2020). These reflective capacities are especially vital in dynamic classroom environments, where teachers must respond to learner feedback, curricular shifts, and contextual constraints.

In mathematics education, such reflection enables teachers to make informed decisions about task design, questioning strategies, and representational choices—often in the moment—based on students' conceptual responses and engagement. Over time, this cultivates a habit of pedagogical reasoning that strengthens lesson coherence and responsiveness to learner needs. In the Philippines, reflective practices such as reflective writing and experiential learning have shown promise in fostering professional growth (Fuego & de Leon, 2025). However, teachers often lack structured support to sustain reflective approaches effectively (Lefebvre et al., 2023).

When applied to GenAI, reflection takes on new urgency. Reflection-in-action enables teachers to adapt AI outputs to classroom realities in real time, while reflection-on-action allows them to analyze why certain AI-generated suggestions were retained, modified, or rejected. This dual lens provides a nuanced understanding of how pre-service teachers navigate GenAI as both a support and a challenge, which is a dimension that has remained largely unexplored in prior studies. Although reflection has been studied in relation to traditional lesson planning (Asfeld & Stonehouse, 2021), its application to GenAI-assisted planning remains underexplored, particularly in non-Western, resource-constrained contexts.

3. Methodology

3.1 Research Design

This study employed a qualitative design situated in the interpretivist paradigm, aiming to capture the reflections of pre-service mathematics teachers while using GenAI tools in lesson planning. Reflexive Thematic Analysis (RTA) was selected for its suitability in examining rich, subjective accounts while recognizing the researcher's interpretive role (Braun & Clarke, 2023). Furthermore, RTA allowed for a nuanced exploration of Schön's (1983) reflective practice framework—specifically, reflection-in-action (real-time reflective thinking during tasks) and reflection-on-action (retrospective insights post-task)—as manifested in participants' cognitive and affective processes. My dual role as researcher and mathematics teacher-educator required continuous reflexivity to ensure balanced interpretation and transparency in theme development.

3.2 Participants

The study was conducted in ED 206: Building and Enhancing New Literacies Across the Curriculum during the second semester of the 2024–2025 academic year at a state university in Iloilo City, Western Visayas, Philippines. Of 31 enrolled first-year pre-service mathematics teachers, 30 consented to participate (9 males, 21 females), while one opted out without penalty. The gender distribution (70% female, 30% male) reflects the documented gender imbalance in Philippine teacher education, whereby women typically constitute the majority (World Bank Group, 2022). This sample size is sufficient for qualitative RTA, in which the goal is thematic depth and transferability rather than statistical generalization (Braun & Clarke, 2023).

Participants were aged 19–22 years, representing novice teacher candidates with varied digital technology exposure but no prior training in structured lesson planning or prompt engineering. Their inclusion was purposeful, as they were uniquely positioned to provide insights into reflection-in-action and reflection-on-action when using GenAI tools in lesson planning. Participation was voluntary, with informed consent being secured prior to data collection. Confidentiality and academic standing protections were assured.

3.3 Data Collection

The study was conducted during a two-week digital literacy module of the ED 206 course, for which lesson planning using GenAI tools was one of the required tasks. The duration aligned with the course's scheduled block, ensuring participants completed a full planning-reflection cycle. To provide a clear overview of the process, the data collection process was structured in six distinct phases, progressing from orientation to final reflection and submission of the finalized lesson plans. Table 1 illustrates this procedure, highlighting the participants' use of GenAI tools in lesson planning.

Table 1: Phases of Data Collection

Phase	Day	Task/Activity
1st	1	**Orientation:** Participants were introduced to ChatGPT (GPT-4, Gemini (2.5 Flash) and Perplexity AI for lesson planning and were warned about potential hallucinations requiring the verification of outputs.
2nd	2-3	**Initial Generation**: Groups selected a Grade 7 mathematics competency from the MATATAG Curriculum (Department of Education, 2021) and structured lessons using the 5As framework—Activity, Analysis, Abstraction, Application, and Assessment. Groups independently formulated prompts for three GenAI tools, with outputs serving as starting points for critical evaluation.
3rd	4-7	**Evaluation**: Groups reviewed GenAI outputs for accuracy, objective alignment, age appropriateness, and engagement.
4th	8-10	**Adaptation**: Participants refined lesson plans by editing content, restructuring activities for student context, and adding tasks to target objectives, emphasizing contextualization and curricular alignment.
5th	11-12	**Documentation**: Groups maintained observation logs and engaged in peer discussions, recording challenges, revisions, and comparative tool insights.
6th	13-14	**Submission**: Participants submitted written reflections responding to: "*What are your reflections on using these three GenAI tools to generate lesson plans?*" These provided rich qualitative data on personal experiences and evaluative thinking.

3.4 Data Analysis

Data analysis employed Braun and Clarke's (2023) six-phase Reflexive Thematic Analysis (RTA), which is well-suited to the interpretivist paradigm and the exploration of pre-service mathematics teachers' reflective experiences with GenAI tools. Analysis began with familiarization through repeated readings of individual reflections, group observation logs, and final drafts of lesson plans in order to identify emergent patterns related to GenAI interactions and reflective processes.

Initial inductive coding was conducted manually using Microsoft Excel, ensuring codes remained grounded in participants' authentic experiences without imposing predetermined frameworks. Next, codes were organized into conceptual clusters, drawing on Schön's (1983) constructs of reflection-in-action (real-time reflective thinking during tasks) and reflection-on-action (retrospective insights post-task). Through iterative refinement, themes were developed, merged, or redefined to capture both dynamic adjustments during lesson planning and post-task insights.

To enhance trustworthiness, a reflexive journal was used to document analytic decisions and researcher positionality. Peer debriefing with an experienced qualitative researcher provided critical feedback, challenging assumptions and strengthening theme development. Discrepant data and negative cases were actively sought to ensure balanced representation and mitigate bias. Finally, the resulting thematic structure was synthesized into a cohesive narrative, with verbatim quotations substantiating each theme and grounding interpretations in authentic data.

3.5 Ethical Considerations

The study adhered to institutional ethical guidelines for classroom research. Written informed consent was obtained from participants, who were informed about the study's purpose, voluntary nature, and data types collected, as well as their rights to withdraw without penalty. Personal identifiers were replaced with codes, and data were securely stored on password-protected devices that were accessible only to the researcher.

Given the dual role of researcher and course facilitator, measures were taken to minimize coercion risks. Participants were assured that participation decisions would not impact academic grades or faculty relations, and ongoing reflexivity addressed potential power imbalances. All published quotations were anonymized to protect identities, and data retention complied with institutional policies, including secure deletion after the prescribed period. Such protocols upheld participant dignity, autonomy, and privacy, ensuring the study's ethical integrity and trustworthiness.

4. Results and Findings

This section addresses the two research questions guiding the study by presenting the five themes that derived from the Reflexive Thematic Analysis of 30 first-year pre-service mathematics teachers' individual reflections and group observation logs. Table 2 shows the summary of themes, codes, and sample quotes from participants' reflection-in-action and reflection-on-action.

Table 2: Summary of themes, codes, and sample quotes of reflection-in-action and reflection-on-action

Theme	Codes	Reflection-in-Action Sample Quotes	Reflection-on-Action Sample Quotes
Streamlining Planning and Stimulating Creativity	faster creation, lesson structure, creative suggestions, idea generation, helpful output	*Using AI made the work easier and faster in terms of creating a lesson plan. – Participant 1*	*AI tools were made for convenience. Generating lesson plans has become easier. – Participant 5*
Fostering Comparative Tool Literacy in GenAI Integration	tool comparison, output differences, strengths and weaknesses,	*ChatGPT stood out due to very imaginative warm-ups. Gemini provided amazing visual presentations and interactive exercises.*	*Each AI had its own strengths and weaknesses. – Participant 26*

	preferences, AI roles	*Perplexity AI was able to provide quite reliable facts.* *- Group 2*	
Emphasizing Prompt Precision and Instructional Clarity	prompt trial-and-error, clarity, grammar sensitivity, instruction quality	*All I need to do is create a prompt, making sure that it is complete and detailed so that the AI tools can generate the content I want. – Participant 5*	*There were times we repeated the prompts to these AI tools because our desired results were not clearly stated. For me, this is one of the weaknesses—it is dependent on the prompts that you provide. – Participant 21*
Negotiating AI Outputs through Pedagogical Judgment	editing output, revising for accuracy, contextual adaptation, content checking, instructional judgment	*I only used those AI-generated suggestions as the basis for my work, and I did not completely follow their content; I only incorporated a few ideas that caught my attention and that would be helpful for the students. – Participant 5*	*There are some gaps – ChatGPT and Gemini AI don't focus much on creative, real-world application, while Perplexity AI lacks structured exercises. – Group 3*
Developing Confidence and Identity as Novice Lesson Designers	confidence boost, reduced fear, guided independence, instructional empowerment, first-time planning	*AI taught me not to be scared of lesson planning anymore, but I still detected the space for human foresight to reshape the material. – Participant 18*	*… All three of them allotted 10 minutes for the assessment… which shows the capability of these three to serve as guides for teachers in planning and conducting classes. - Group 4*

4.1 How do pre-service mathematics teachers engage in reflection-in-action when using GenAI tools during lesson planning?

4.1.1 *Theme 1: Streamlining planning and stimulating creativity*

Participants described the ways in which GenAI tools supported their lesson planning by reducing cognitive load and offering structured, engaging content. This efficiency enabled participants to allocate time to other pedagogical tasks, including developing classroom management skills, designing instructional materials, and preparing student assessments. Participant 1 observed:

> "*Using AI made the work easier and faster in terms of creating a lesson plan.*"

This sentiment was echoed by Participant 21, who explained:

> "*There were some parts of the lesson plan where we followed the suggestions of the AI tools because we felt they would really help make our lesson plan better and more structured.*"

Group 1 provided a specific example:

> "*Gemini's Problem-Solving Challenge is the best because it offers a variety of word problems with increasing difficulty.*"

These reflections demonstrate that participants engaged in real-time pedagogical decision-making to selectively incorporate GenAI-generated suggestions that aligned with their instructional objectives.

4.1.2 *Theme 2: Fostering comparative tool literacy in GenAI integration*

Participants developed critical discernment by engaging with multiple GenAI platforms: ChatGPT, Gemini, and Perplexity AI. This comparative process enabled participants to identify each tool's unique affordances and limitations, thereby shaping their instructional decisions in context-specific ways. Participant 1 articulated this observation:

> "*Each tool had its strengths, such as ChatGPT providing structured responses, Gemini offering engaging activities, and Perplexity AI delivering in-depth explanations.*"

Participant 9 elaborated on the advantage of comparison:

> "*I liked how I could quickly compare options and refine them to create a lesson plan that's both effective and engaging.*"

Group 2 identified tool-specific strengths:

> "*ChatGPT stood out due to very imaginative warm-ups. Gemini provided amazing visual presentations and interactive exercises. Perplexity AI was able to provide quite reliable facts.*"

Group 4 selected an activity that they thought students would most benefit from:

> *"ChatGPT's activity gives a good warm-up activity and makes the student engage [in] and explore the lesson while also assessing their knowledge and ideas regarding the topic. It is a perfect activity to introduce the lesson to the students."*

These reflections demonstrate the immediate, situated judgments participants made with regard to which tool best supported their lesson design goals and their students' needs. The act of comparing GenAI outputs in real time and selecting tools based on their alignment with learning objectives and with the students' needs demonstrates active pedagogical reasoning aimed at optimizing student learning experiences.

4.1.3 *Theme 3: Emphasizing prompt precision and instructional clarity*

Participants recognized that developing prompt engineering skills was essential to leveraging these tools' potential for supporting teaching-related workflows. Participant 5 explained:

> "*All I need to do is create a prompt, making sure that it is complete and detailed so that the AI tools can generate the content I want.*"

However, Participant 15 acknowledged the challenge inherent in this process:

> "*I only experience difficulties in constructing the right prompt or command for the AI to provide me with specific and correct answers.*"

Group 2 identified tool-specific prompting requirements:

> "*ChatGPT needs good directing to maximize effectiveness; however, it sometimes provides too-long answers.*"

Collectively, these reflections revealed participants' real-time adjustments to prompt formulation as they sought to improve the relevance of the outputs. Through trial-and-error experimentation with different prompt formulations and frameworks, participants developed critical judgment regarding which prompt characteristics—appropriateness, completeness, clarity, and directness—yielded the most suitable outputs for their lesson planning goals.

4.1.4 *Theme 4: Negotiating AI outputs through pedagogical judgment*

Participants described critically engaging with GenAI-generated content by selecting, modifying, and aligning outputs with curriculum standards and students' needs. Rather than accepting GenAI suggestions uncritically, they exercised pedagogical judgment to ensure instructional relevance and coherence. Participant 5 articulated this selective approach:

> "*I only used those AI-generated suggestions as the basis for my work, and I did not completely follow their content; I only incorporated a few ideas that caught my attention and that would be helpful for the students.*"

Participant 3 emphasized the necessity of human-driven adaptation:

> "*AI-generated lesson plans needed to be modified to better correspond with curriculum standards and specific learning objectives.*"

Group 6 made sure that they screened and filtered the generated output:

> "*In our case, we don't just copy what is generated; we've gone through a series of research just to validate the data provided by the AI tools."*

Group 4 identified which of the GenAI outputs were suitable for the students:

> *"ChatGPT is more on the discussion side, and students might get bored because of a lack of participation, and Perplexity AI is focused on interactive learning; students might not learn with all the chaos, while in the case of Gemini, it combines both ideas, balancing both presentation and discussion."*

These reflections illustrate the ways in which participants made situated decisions regarding whether to adapt GenAI outputs to their specific instructional contexts. Rather than uncritically adopting AI-generated content, participants actively customized lesson plans to address the needs of their target students and ensure alignment with instructional objectives. Furthermore, they also made deliberate efforts to validate these outputs, carefully assessing their credibility and pedagogical soundness.

Indeed, participants' engagement involved a thoughtful evaluation of clarity, practicality, and curricular alignment throughout the lesson design process. This demonstrated their pedagogical agency in reconciling AI-generated suggestions with the realities of classroom practice, shaped by their awareness of potential GenAI hallucinations and reliability concerns. For further illustration, Table 3 presents the ways in which participants modified their work instead of fully adopting GenAI outputs.

Table 3: Examples of AI output adaptation by the participants

AI tool used	Original Output	Participant Modification	Key Modifications
Chat GPT	*ACTIVITY* *"What Belongs?"* *Strategy: Class Discussion &* *Brainstorming* *1. Show students different groups of objects (e.g. colors of the rainbow, types of transportation, random letters, numbers).* *2. Ask:* *o What do you notice about these groups?* *o Can you describe a rule that defines each group?* *o Are there items that do not belong in any group?*	*ACTIVITY* *Take a look at these objects. What can you say about the objects?* *Which of the following does not belong to the group?* *Can you describe a rule that defines each group?* 	The participants made the activity more engaging by using colorful pictures and asking questions directly addressed to students. Examples of items that students can relate to are selected.
Gemini	*ABSTRACTION:* *Title: "Rules of the Sets"* *Procedure:* *1. Summarize the key concepts:* • *Definition of a set and a Venn diagram.* • *Representation of set operations (union, intersection, difference) in Venn diagrams.*	*ABSTRACTION:* *Discussion Questions:* • *What is a set? What are its elements?* • *How can we visually represent relationships between sets?* *Guided Practice:* *Present a simple example:* *Set A = 1, 2, 3* *Set B = 3, 5, 7*	The participants ask questions addressed to their target students. An example was purposefully selected so that students could easily

		Use a two-circle Venn diagram to show overlap (3).  	understand the Venn Diagram.
Perplexity AI	*APPLICATION (Practice Skills)* • *Distribute activity sheets with exercises such as: Represent sets using both roster and rule methods.*	*APPLICATION* I. *Write the following in the roster method.* a. *Set A contains odd numbers less than 10.* b. *Set B contains the first five planets of the solar system.* II. *Write the following in set builder notation.* a. *C = {2, 4, 6, 8, …}* b. *D = {a, e, i, o, u}*	The participants made the application more complete and specific.

4.1.5 *Theme 5: Developing confidence and identity as novice lesson designers*
Participants described how engaging with GenAI tools helped them to overcome their initial anxieties about lesson planning and cultivate their self-perception as capable instructional designers. The structured outputs and diverse pedagogical suggestions provided by ChatGPT, Gemini, and Perplexity AI contained both scaffolding and creative inspiration. Participant 21 observed:

> "*Using AI tools such as ChatGPT, Gemini, and Perplexity AI really helped us create a well-structured and effective lesson plan.*"

Participant 18 articulated a transformative shift in perspective:

> "*AI taught me not to be scared of lesson planning anymore, but I still detected the space for human foresight to reshape the material.*"

Group 5 demonstrated emerging pedagogical reasoning in their tool selection:

> "*We chose Gemini because it allows students to apply their knowledge and understanding about real numbers and encourages students to develop their analytical skills.*"

Together, these reflections captured participants' growing confidence as they actively engaged with AI-generated content. Participants began reconceptualizing lesson planning not as an overwhelming task but as a manageable creative process, supported by both technological tools and their own developing professional judgment.

4.2 What insights emerge through reflection-on-action after completing AI-assisted lesson plans?

4.2.1 *Theme 1: Streamlining planning and stimulating creativity*

After completing their lesson plans, participants reflected on the ways in which GenAI had transformed their planning processes. Participants recognized retrospectively how GenAI tools had transformed their planning approaches and revealed new instructional possibilities. Participant 5 reflected on this transformation:

> "*AI tools were made for convenience. Generating lesson plans has become easier.*"

Participant 23 noted the pedagogical value of this experience:

> "*It gave me innovative ideas that can be valuable for future use as a pre-service teacher.*"

Group 2 elaborated on the quality of AI-generated suggestions:

> "*These AI platforms provided great suggestions that could truly be incorporated into our lesson plan. The suggested activities were not only enjoyable and entertaining but also educational.*"

Participants across groups consistently identified efficiency gains and creative stimulation as being the dual benefits of GenAI integration in lesson planning. Additionally, they reconceptualized GenAI tools not merely as a time-saving instrument but as a collaborative partner in their evolving pedagogical practice.

4.2.2 *Theme 2: Fostering comparative tool literacy in GenAI integration*

Participants engaged in reflection-on-action by revisiting their experiences to consolidate their understanding and articulate broader insights relating to strategic GenAI integration. Participant 24 synthesized these distinctions:

> "*I just realized that Perplexity AI is useful for research and material enrichment, Gemini provides quick, well-structured plans, and ChatGPT is perfect for flexible and creative lesson planning.*"

Participant 26 concisely captured this awareness:

> "*Each AI had its own strengths and weaknesses.*"

Group 3 recognized the potential for complementary tool use:

> "*ChatGPT and Gemini focus on tangible objects but could include more abstract discussions but lack hands-on classification activities. If combined, these strategies would create a well-rounded experience.*"

Group 4 identified the best way to use each of these tools:

> "*Starting with real-life scenarios, ChatGPT would help students connect math to their daily lives, followed by number line exploration. Gemini provides a clear visual representation of integer operations, and concluding with the sorting challenge, Perplexity AI would reinforce the concepts through peer collaboration and critical thinking.*"

In summary, the participants realized that GenAI tools are not interchangeable tools but rather complementary resources, each of which offers distinct pedagogical affordances that can benefit their lesson planning and instructional design. Understanding this is very important so that pre-service teachers can easily identify the tools needed for a specific task. This emerging tool literacy represents a critical competency for technology-enhanced teaching in contemporary educational contexts.

4.2.3 *Theme 3: Emphasizing prompt precision and instructional clarity*

Participants recognized both the iterative nature of prompt refinement and the necessity of critically evaluating AI-generated content for pedagogical coherence and clarity. Participant 14 described this iterative approach:

> "*We had to generate [it] multiple times and get the best data each could offer.*"

Participant 21 articulated the dependency relationship between input and output quality:

> "*There were times we repeated the prompts to these AI tools because our desired results were not clearly stated. For me, this is one of the weaknesses—it is dependent on the prompts that you provide.*"

Group 4 emphasized the importance of critical review:

> "*We realized we must always check the AI's output to ensure clarity for students' understanding of the topic.*"

Through reflection-on-action, participants consistently identified prompt precision as both an essential competency and an ongoing challenge in effective GenAI utilization. Effective outcomes were critically dependent on their developing proficiency in prompt formulation and refinement—a skill set that is increasingly recognized as being foundational to productive human-AI interaction in educational contexts.

4.2.4 *Theme 4: Negotiating AI outputs through pedagogical judgment*

After completing their lesson plans, participants reflected on the strengths and limitations they had identified in AI-generated content. Participant 11 described this comparative analytical process:

> "*When comparing lesson plans, I can see the strengths and weaknesses of different AI tools, which encourages me to think critically and analyze which ideas align best and have the most impact on our lesson plans.*"

Participant 15 highlighted the importance of critical review for inclusive practice:

> "*AI tools can suggest fun activities, quizzes, and ways to teach students with different needs. However, it is important to check and edit the AI's work to make sure it is correct and fits the lesson goals.*"

Group 6 realized that AI can generate inaccurate information:

> *"We stumbled upon the inaccurate data that had been generated by the AI, which led us to realize that AI can also provide incorrect, incomplete,*

> *or misleading data, especially when we used it to generate a lesson plan that served as the basis for our own."*

Group 3 identified specific pedagogical gaps requiring human intervention:

> "*There are some gaps – ChatGPT and Gemini AI don't focus much on creative, real-world application, while Perplexity AI lacks structured exercises.*"

Participants consistently positioned themselves as active evaluators rather than passive recipients of AI-generated content. Retrospectively, they realized that they needed to fact-check every piece of content generated by the GenAI tools. Moreover, the participants also attempted to analyze the strengths and limitations of various GenAI tools, considering how to enhance inclusivity, accuracy, and real-world relevance in their lesson plans.

4.2.5 *Theme 5: Developing confidence and identity as novice lesson designers*

Participants retrospectively recognized the ways in which GenAI tools had expanded their pedagogical perspectives and facilitated their internalization of core instructional design principles. Participant 18 reflected on this developmental trajectory:

> "*As a first year, using AI tools for lesson planning has opened my eyes. In doing so, it provided me [with] a glimpse of the structure of lesson plans and highlighted the things I must include.*"

Participant 27 articulated their broadened pedagogical awareness:

> "*It showed me how different teaching ideologies using each of these tools can open my eyes to unique ways of designing lessons.*"

Group 6 recognized the creativity of different AI tools, which increased the participants' confidence in creating lesson plans:

> *"AI can also be a source of creative inspiration by suggesting innovative teaching styles and new ways to present the lessons. Innovation, or bringing a new teaching style into a classroom, will make the students interested, and that will give us confidence in planning our lessons."*

Group 4 recognized the consistency and pedagogical validity of AI-generated structures:

> "*… all three of them allotted 10 minutes for the assessment… which shows the capability of these three to serve as guides for teachers in planning and conducting classes.*"

Participants consistently identified GenAI as being instrumental in developing their confidence and professional identity as lesson designers. Thus, through this reflective process, pre-service teachers are able to plan their lessons without fear. They can be guided by the various innovations suggested by these tools. With GenAI by their side, they have a collaborator, a co-brainstormer, an assistant, and a guide, all of which are ready to generate ideas for the various activities needed in a lesson plan.

5. Discussion

This study explored the ways in which pre-service mathematics teachers engage in reflective practices during and after the use of GenAI tools for lesson planning. Framed by Schön's (1983) concepts of reflection-in-action and reflection-on-action, the findings reveal complex, iterative reflective processes that shape the pre-service mathematics teachers' interaction with GenAI tools as well as their professional development.

5.1 Reflection-in-Action: Adaptive Engagement with GenAI

With regard to the ways in which pre-service mathematics teachers engage in reflection-in-action, the findings demonstrate that participants actively position themselves as thoughtful practitioners, addressing the potential benefits and challenges of using GenAI tools during lesson design. The dual theme of streamlining planning and stimulating creativity affirms GenAI's facilitation of efficiency and innovation, echoing recent studies that highlight AI's capacity to alleviate cognitive load and foster instructional creativity (Gurl et al., 2025; Yanar & Ergene, 2025; Almuqayteeb, 2025).

Through their careful yet immediate selection of AI-generated ideas, participants demonstrated Schön's notion of "thinking on your feet," actively responding to and making informed choices in response to GenAI suggestions. Participants found that they were able to save a lot of time in creating their lesson plans, leaving them additional time for more important pedagogical activities inside the classroom, such as teaching students.

Furthermore, the emergence of comparative tool literacy highlights the development of adaptive expertise among pre-service teachers, which is an essential factor for successful AI integration (Knoth et al., 2024; Celik, 2023). As participants engaged in continual assessment and adjustment of the outputs from ChatGPT, Gemini, and Perplexity AI, their experiences emphasize that AI literacy must include not only operational proficiency but also strategic decision-making and the intentional application of tools (Cain, 2024). Such flexible tool fluency equips teachers to better address diverse pedagogical demands and enhances the quality of lesson planning. By applying their increasing knowledge of the strengths and weaknesses of each tool, they will be able to select the best tools to help them in each specific task.

The reflective focus on prompt precision and instructional clarity reveals a crucial skill that is foundational to effective AI utilization. Through deliberate prompt engineering and continuous iterative refinement, participants demonstrated metacognitive monitoring that is essential for steering large language model outputs toward pedagogical relevance (Tassoti, 2024; Santos & Villanueva, 2023). Honing this skill will make them more efficient as pre-service teachers, enabling them to use GenAI tools to their full potential by selectively applying various prompt engineering techniques. This underscores the urgent need to integrate prompt engineering training in teacher education programs in order to ensure that pre-service teachers are adept in AI-enhanced instructional design (Knoth et al., 2024).

Equally importantly, the theme of negotiating AI outputs through pedagogical judgment marks participants' assertion of professional agency, aligning with Schön's reflections on the artistry of teaching (Schön, 1983). Teachers' critical selection and adaptation of AI content ensure alignment with curriculum standards and learner variability, reinforcing teachers' role as ethical gatekeepers amidst technological mediation (Makarenko et al., 2024; Kasneci et al., 2023).

Lastly, developing confidence and professional identity as novice lesson designers highlights GenAI's scaffolding role. Participants' reports of reduced anxiety and emergent instructional self-efficacy resonate with the literature linking scaffolded technological engagement to identity formation (Muncey, 2024; Liu & Trent, 2023; Alrwaished, 2024). Collectively, these findings advance the current understanding of AI's potential to transform not only task facilitation but also teachers' professional growth.

5.2 Reflection-on-Action: Deeper Insight and Strategic Professional Growth

In terms of their insights from reflection-on-action, participants exhibit deeper, more integrative pedagogical understanding after completing the lesson plan with GenAI. Participants valued GenAI's role in enhancing planning efficiency and sparking creative ideas, supporting prior claims of AI acting as a catalyst for sustainable pedagogical innovation (Antonio et al., 2024; Almuqayteeb, 2025; ElSayary, 2024). In addition to this, participants' reflections also reveal the maturation of comparative tool literacy into strategic decision-making with regard to AI integration. This aligns with growing calls for professional judgment to be applied in AI use, ensuring that teachers purposefully combine tool affordances to optimize learning experiences (Kalenda et al., 2024; Jain, 2024).

Furthermore, reflection-on-action reveals a deeper appreciation for prompt precision as a foundational competency. Participants clearly came to understand that effective AI-mediated teaching demands iterative prompt design paired with critical evaluation, echoing frameworks that emphasize prompt engineering as essential AI literacy for educators (Cui & Zhang, 2025; Santos & Villanueva, 2023). Critically, reflection-on-action highlighted the ethical and curricular evaluation of AI content, with participants recognizing the teacher's continuing responsibility to oversee and refine AI outputs for inclusivity and accuracy. This insight responds to emerging concerns regarding AI's limitations and the risk of content hallucination and underscoring the necessity of teacher agency (Cui & Zhang, 2025; Kasneci et al., 2023).

Finally, participants' broader pedagogical perspectives and identity growth attest to GenAI's potential to reshape teacher development pathways. Taken together, their reflections affirm that AI tools serve as scaffolding for their development as reflective professionals, expanding the conceptualization of teacher identity in technologically enriched landscapes (Lefebvre et al., 2023).

6. Conclusion

This study explored the ways in which pre-service mathematics teachers engaged in reflective practice when using GenAI tools for lesson planning, guided by

Schön's (1983) framework. Five themes emerged, as follows: streamlining planning and stimulating creativity; fostering comparative tool literacy in GenAI integration; emphasizing prompt precision and instructional clarity; negotiating AI outputs through pedagogical judgment; and developing confidence as novice lesson designers. During reflection-in-action, participants made situated decisions relating to the adoption or modification of AI suggestions based on instructional alignment and students' needs.

Through reflection-on-action, they gained a deeper understanding of tool affordances, identified pedagogical gaps requiring human oversight, and developed their own professional identities as critical technology users. Participants positioned GenAI as a collaborative partner, a talented assistant, and a co-brainstormer with an endless supply of ideas, nevertheless requiring their active mediation rather than providing autonomous solutions; appropriate pedagogical judgment needed to be exercised to ensure curricular alignment, accuracy, and ethical practice.

These findings have critical implications for teacher education programs, especially in resource-constrained contexts like the Philippines. Effective GenAI integration requires not just access but structured training in prompt engineering, critical AI evaluation, and ethical reflection. Institutions are encouraged to craft AI policies to guide responsible use, offer multi-tool comparison experiences to build strategic literacy, and explicitly teach fact-checking and bias detection as core competencies. Scaffolding AI-supported planning that gradually fades toward autonomy can foster pedagogical agency.

While GenAI tools help address lesson planning challenges, they amplify—rather than replace—the need for reflective judgment. As GenAI capabilities advance, curriculum frameworks should promote ethical reasoning, contextual adaptation, and informed professional judgment. This study demonstrates that pre-service teachers in developing contexts can develop sophisticated GenAI literacy through structured engagement, challenging deficit narratives and reaffirming that the irreplaceable human dimensions of teaching remain central to equitable and effective education.

7. Limitations

Despite its unique contributions to the literature, this study has several limitations. First, the sample was limited to 30 first-year pre-service teachers from a single state university in Iloilo City, Western Visayas, Philippines, which constrains transferability to broader institutional or cultural contexts. Data collection was conducted over a short period of only two weeks, capturing initial rather than sustained engagement with GenAI tools. Reliance on self-reported reflections and logs may involve biases such as social desirability and selective recall, while the absence of observational or interview data restricts depth.

Additionally, the researcher's dual role as facilitator and investigator may have subtly shaped responses and interpretations. Finally, the focus on three specific GenAI tools—ChatGPT (GPT-4), Gemini (2.5 Flash), and Perplexity AI—limits the

generalizability of the findings to other platforms. Future studies could therefore benefit by adopting longitudinal, mixed-methods approaches with more diverse samples, integrating observations and interviews, and testing different AI tools across a range of pedagogical settings, particularly in resource-constrained contexts.

8. AI Tool Disclosure

During manuscript preparation, Perplexity AI was utilized to assist with manuscript structuring, clarity enhancement, organization improvement, and language refinement. All AI-generated content and suggestions were reviewed and edited by the author to ensure accuracy, originality, and appropriate scholarly attribution. The author retains full responsibility for the integrity and final content of this work.

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