

**Lived experiences of Filipino migrant teachers in integrating AI-powered tools
in mathematics instruction**

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ABSTRACT

In the heart of a U.S. public school district, the authentic classroom journeys of Filipino migrant mathematics teachers integrating AI-powered tools unfold revealing triumphs, trials, and transformative insights. This phenomenological study explored the experiences of twelve (12) Filipino migrant mathematics teachers integrating AI-powered tools in a U.S. public school district during the 2024–2025 school year. Through in-depth interviews and thematic analysis using Collaizi's method, the research aimed to identify the opportunities, challenges, coping strategies, and implications for an effective enhancement plan. Findings revealed that AI tools offered significant benefits, including enhanced teaching efficiency, personalized instruction, increased student engagement, and improved formative assessment. However, teachers encountered substantial challenges: student over-reliance threatening academic integrity, inequitable access to technology, technical and pedagogical hurdles, and the need to balance AI use with foundational skill development. In response, teachers employed adaptive strategies such as selective AI integration, promoting critical thinking, collaborative workarounds for access gaps, and self-directed professional learning. The study concludes that successful AI integration requires a holistic framework that addresses infrastructure, pedagogy, professional development, and school culture. Based on these insights, the Mathematics Teaching Enhancement Plan through Responsible AI Integration (MERAI-PLAN) is proposed. This actionable plan provides a structured roadmap with targeted objectives, strategies, and monitoring mechanisms to support equitable, ethical, and effective AI adoption in mathematics classrooms.

Keywords: Mathematics Teaching, AI in Education, Educational Technology, Phenomenological Study, Enhancement Plan.

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INTRODUCTION

Mathematics constitutes a foundational competency embedded in the practical, civic, professional, recreational, and cultural dimensions of human life (Little, 2018). Beyond its intrinsic academic value, mathematics equips individuals with essential problem-solving

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abilities, quantitative literacy, and the capacity to navigate an increasingly complex, data-driven world (Nzeadibe et al., 2020). In the contemporary global landscape characterized by rapid technological advancement, having the confidence and capability to engage with mathematics has become more critical than ever, particularly as artificial intelligence technologies reshape how mathematical concepts are taught, learned, and applied (Okeke et al., 2023). This intersection of mathematical competency and technological transformation has created both unprecedented opportunities and urgent challenges for mathematics educators worldwide, challenges that are rendered even more complex for teachers who operate across cultural and national boundaries.

The integration of AI-powered tools in mathematics instruction represents a paradigm shift in pedagogical practice. AI technologies including intelligent tutoring systems, adaptive learning platforms, automated assessment tools, and generative AI applications are fundamentally transforming the teaching and learning of mathematics across educational contexts worldwide (Mohamed Zuhilmi et al., 2022). These tools offer unprecedented capabilities for personalizing instruction, providing real-time feedback, generating dynamic visualizations of abstract concepts, and creating engaging, gamified learning experiences that were previously impossible to implement at scale. The pedagogical promise of these technologies is substantial, yet their realization in authentic classroom settings remains far from uniform, raising critical questions about the conditions under which AI tools genuinely enhance mathematics learning and instruction.

Despite this transformative potential, a concerning paradox has emerged. The Sustainable Development Goals Report (2023) projects that approximately 300 million students globally will lack basic numeracy and literacy skills by 2030 if mathematics education continues to be devalued even as advanced AI technologies proliferate in educational settings. This disconnect between technological availability and educational outcomes suggests that the mere presence of AI tools does not automatically translate into improved mathematics learning. The gap between what AI can theoretically offer and what teachers and students actually experience in technologically equipped but pedagogically under-supported classrooms underscore the necessity of examining not only the tools themselves but the human processes through which those tools are integrated into instruction.

A growing body of research has examined how teachers and students use AI-powered tools in mathematics education across a range of applications, from solving procedural problems through step-by-step solvers, generating worked examples on demand, modeling abstract concepts such as dynamic geometry with AI feedback, to automated formative assessment through instant error analysis. However, significant gaps remain in understanding how teachers actually implement these tools in authentic, resource-constrained classroom contexts, particularly among migrant educators. The existing literature, while informative, has produced findings that are both fragmented and insufficiently attentive to the lived realities of teachers who must navigate the pedagogical, institutional, and emotional complexities of AI integration on a daily basis.

Synthesizing the existing literature reveals three critical tensions that remain unaddressed. First, while Melchor et al. (2023) found that AI enhances critical thinking and adaptive instruction in Philippine tertiary classrooms, they also documented persistent infrastructure limitations including unreliable electricity and slow internet connectivity, as well as data privacy concerns. Second, Zhang et al. (2023) demonstrated that perceived ease of use and usefulness drive AI adoption among German university students, with AI-related anxiety acting as a significant moderator, but their sample did not include teachers who must simultaneously manage student anxiety, curriculum pacing, and technological breakdowns. Third, Afidchao (2023) reported that Filipino senior high school students' express enthusiasm for AI-powered calculators yet worry about the erosion of genuine learning through the

bypassing of conceptual understanding. Taken together, these studies describe what teachers and students think about AI tools, but they remain descriptive and fragmented. No study has synthesized how Filipino migrant teachers, who navigate cross-cultural pedagogical expectations, limited technical support abroad, and diverse learner mathematics proficiencies, actually integrate AI for problem-solving, example generation, concept modeling, and assessment in their daily mathematics instruction. Consequently, the lived experiences of these teachers, including their moment-to-moment decisions, emotional responses, and adaptive strategies, remain a critical blind spot in the literature.

Beyond these specific tensions, the existing body of research shares several critical limitations that collectively constrain its applicability to the present study's focus. The overwhelming majority of research concentrates on higher education contexts, leaving basic education significantly under-examined despite being the foundational level where mathematical competencies are initially developed. Existing literature predominantly focuses on student perspectives and outcomes, with insufficient attention to teachers lived experiences, pedagogical decision-making processes, and the professional challenges they navigate when integrating AI tools into instruction. Most significantly, studies typically examine AI in mathematics education as a broad phenomenon rather than investigating the specific mechanisms, strategies, and processes through which teachers integrate AI-powered tools into mathematics instruction. This distinction is pedagogically crucial, as it captures the complex and often invisible labor of translating technological possibility into situated teaching practice.

This gap is particularly pronounced in the context of migrant teachers, who navigate the dual challenge of adapting to new educational systems while simultaneously learning to integrate emerging technologies into their practice. Filipino migrant teachers, who constitute a significant and growing contingent of mathematics educators in international settings including the United States, represent an entirely unexplored population whose experiences could yield valuable insights into the dynamics of cross-cultural technology integration (Arcillo, 2023; Borja Martin, 2022). Their perspectives on AI integration, shaped by Philippine teacher preparation, sustained international teaching experiences, and ongoing adaptation to host country educational expectations and institutional cultures, remain entirely unexamined in the scholarly literature. This represents not merely an empirical gap but an equity concern, as the professional knowledge and adaptive expertise accumulated by this population of educators have yet to be recognized, documented, or mobilized in the service of broader pedagogical understanding.

The present study addresses these gaps by investigating the lived experiences of Filipino migrant mathematics teachers integrating AI-powered tools in a United States public school district. Rather than examining AI in mathematics education as a broad phenomenon, this research specifically focuses on the integration process itself, the opportunities teachers identify, the challenges they encounter, and the coping strategies they develop when embedding AI tools into mathematics instruction. This focus on process rather than outcome, and on teacher experience rather than student performance, represents a deliberate methodological and ethical commitment to centering the voices of a population whose expertise has been systematically overlooked in the research literature.

The urgency of this investigation cannot be overstated. As AI technologies rapidly evolve and proliferate in educational settings, teachers are being asked to integrate tools whose pedagogical implications are poorly understood, within systems that provide inadequate training and support, while serving diverse student populations with varying degrees of technological access and readiness. The absence of research-informed frameworks for AI integration in mathematics instruction leaves teachers to navigate this complex terrain through

individual trial and error, resulting in inconsistent implementation practices, inequitable student experiences, and missed opportunities for transformative teaching and learning. The cost of this research deficit is borne most acutely by teachers who lack institutional support and by the students whose access to effective mathematics instruction depends on those teachers' ability to integrate technology thoughtfully and confidently.

Filipino migrant teachers in United States schools occupy a unique position at the intersection of multiple educational cultures, pedagogical traditions, and technological contexts. Their experiences integrating AI-powered tools, as they navigate between Philippine educational foundations and American classroom expectations, offer a rich and underexplored source of knowledge about how AI can be effectively and contextually integrated across cultural settings. Understanding their successes, struggles, and adaptive strategies is essential not only for supporting this specific population of educators but for developing culturally responsive and pedagogically sound frameworks for AI integration that can benefit mathematics teachers and students across diverse educational environments. This study responds to the urgent need for research that centers teachers' voices, examines authentic classroom integration, and generates actionable knowledge for policy, practice, and professional development. By documenting the lived experiences of Filipino migrant mathematics teachers integrating AI-powered tools, the study aims to bridge the gap between AI's technological potential and its pedagogical reality, contributing to the development of evidence-based frameworks that can guide equitable, effective, and sustainable AI integration in mathematics instruction across diverse and cross-cultural educational contexts.

Statement of the problem

This study aimed to explore the lived experiences of Filipino teachers integrating educational AI-powered application tools in teaching Mathematics in a public school district in the USA during the school year 2024 to 2025, as basis for an enhancement plan for mathematics teaching integrating AI-powered tools.

Specifically, this study answered the following questions:

1. What are the opportunities of the participants in integrating educational AI-powered tools in teaching Mathematics?
2. What are the challenges encountered by the participants in integrating educational AI-powered tools in teaching Mathematics?
3. What are the coping strategies used by the participants in mitigating challenges encountered in integrating AI-powered tools in teaching Mathematics?
4. What enhancement plan for teaching mathematics using AI-powered tools can be proposed?

METHODOLOGY

This study employed a transcendental phenomenological design to explore the lived experiences of Filipino migrant teachers integrating AI-powered tools into mathematics instruction. This research design was selected and justified by the under-researched nature of the topic, as it prioritizes understanding what participants experienced and how they experienced the phenomenon while requiring the researcher to bracket personal biases in order to allow authentic and essential meanings to emerge from the data. Through inductive methods including in-depth interviews and reflective discussions, the study aimed to uncover common experiential structures that can meaningfully inform practice, policy, and future research in the field of AI-enhanced mathematics education.

The study was conducted in the Jackson Public School District (JPS) in Mississippi, USA, identified as the third largest school district in the state and one that serves over 80% of school-aged children in the city of Jackson. Participants were twelve Filipino migrant mathematics teachers purposively selected from eight schools within the JPS system. All participants met five inclusion criteria established by the researcher: they hold licensure as mathematics teachers in both the Philippines and the United States, they are currently teaching mathematics within the JPS district, they are Filipino migrant workers residing in the USA, they actively use AI-powered tools on a weekly basis in their mathematics instruction, and they are willing to share their professional experiences openly and reflectively. This sample size is consistent with the norms of transcendental phenomenological research, which prioritizes rich and information-dense cases capable of generating deep experiential insight over statistical generalizability.

The primary research instrument used in this study was a semi-structured interview guide developed to explore the lived experiences of the twelve Filipino migrant mathematics teacher participants in the Jackson Public School District. The interview guide was constructed following phenomenological principles that emphasize the use of open-ended "what" and "how" questions to elicit experiential narratives rather than evaluative or closed responses. The instrument underwent rigorous content validation conducted by three subject matter experts, each of whom rated every item for relevance and clarity. All 16 items in the initial version of the guide achieved perfect relevance scores, with an Item-Level Content Validity Index (I-CVI) of 1.00 for each item. The overall Scale-Level Content Validity Index calculated using the average method (S-CVI/Ave) was 0.98, which exceeded the recommended threshold of 0.90 for research instruments. Based on expert feedback, necessary revisions were made, including the removal of a duplicate question, and the final instrument was organized into four thematic sections covering background information, opportunities in AI integration, challenges encountered during integration, and participant reflections with future perspectives.

The study employed Colaizzi's seven-step framework of thematic analysis to analyze the data gathered through the semi-structured interviews. The analytical process began with data familiarization, during which the researcher read and reread the interview transcripts to develop a thorough and immersive understanding of the participants' accounts. Significant statements directly relevant to the phenomenon of AI integration in mathematics instruction were then extracted from the transcripts. The underlying meanings of these significant statements were formulated and articulated in the researcher's own interpretive language. Related formulated meanings were subsequently clustered into emergent themes that captured common patterns and structures across participant narratives. These emergent themes were then synthesized into an exhaustive description of the phenomenon as a whole, which was further distilled into a fundamental structure representing the essential core experience of integrating AI-powered tools in mathematics instruction as lived by Filipino migrant teachers. Finally, member checking was conducted by returning interpretations to participants for review and confirmation, a step intended to validate the accuracy of the findings, eliminate researcher bias, and enhance the overall credibility and trustworthiness of the study's conclusions.

RESULTS AND DISCUSSION

This section presents the results and discussion of a transcendental phenomenological study involving twelve Filipino migrant mathematics teachers purposively selected from eight schools within the Jackson Public School District (JPS) in Mississippi, USA, during the 2024 to 2025 school year. Data were gathered through semi-structured interviews analyzed using

Colaizzi's seven-step thematic analysis framework, which enabled the identification of essential experiential structures from participants' narratives. The discussion that follows is grounded entirely in the data gathered and is interpreted in direct relation to the four research objectives of the study, namely the identification of opportunities, challenges, coping strategies, and systemic implications associated with AI-powered tool integration in mathematics instruction. The analysis revealed four major themes: *Where Innovation Awakens: Unveiling Opportunities in AI-Powered Integration*; *Shadows Along the Path: Exploring Challenges in AI-Powered Integration*; *Threads of Resilience: Weaving Strategies to Overcome Integration Challenges*; and *Seeds of Transformation: Insights Shaping the Path to an Enhanced Future*. These themes are not discrete categories but interconnected and mutually illuminating dimensions of a unified phenomenon, and each is discussed in depth in the sections that follow.

Where innovation awakens: Unveiling opportunities in AI-powered integration

The first major theme captures the positive outcomes and transformative potential that all 12 participants (100%) experienced when integrating AI-powered tools into their mathematics instruction. Four sub-themes emerged from the participants' narratives: *Enhanced Teaching Efficiency and Lesson Preparation*, *Personalized and Differentiated Instruction*, *Increased Student Engagement and Interaction*, and *Facilitation of Formative Assessment and Feedback*.

All 12 participants (100%) unanimously reported that AI-powered tools substantially reduced the time and cognitive load associated with lesson planning and resource creation. Teachers described using AI applications to automate the generation of lesson outlines, activity sheets, practice problems, and presentations, thereby freeing valuable time for direct student interaction and instructional refinement. Maria, a high school mathematics teacher with eight years of teaching experience in the Philippines and two years in the United States, stated: "It saves me time in preparing my lesson. It is easier and faster to make activities for my class. Before, I would spend hours creating worksheets from scratch or adapting materials from textbooks. Now, I can generate differentiated practice sets in minutes and spend that saved time working one-on-one with students who are struggling." Jose, who teaches at a middle school, further emphasized the time management implications of AI integration: "It helped me make the teaching-learning process easier and helps with my time management. When you're a migrant teacher, you're not just learning a new curriculum, you're learning a whole new educational system. AI tools have been like having a teaching assistant that helps me keep up with the demands." Elena, a veteran teacher of 15 years, articulated how efficiency gains enabled creative liberation: "You don't have to create plans and presentations from scratch. AI generates the foundation, and then I can focus my energy on making it better, adding my own examples, anticipating where my students might struggle, thinking about how to make the lesson come alive. It's not about replacing my work; it's about letting me do my best work."

The unanimity of participant responses on this sub-theme (12 out of 12, 100%) reflects strong and consistent agreement that AI's efficiency benefits are both real and pedagogically significant. This finding aligns with Aslam et al. (2025), who found in their rapid evaluation of AI-generated lesson plans that tools like MagicSchool.ai reduced teacher planning time by approximately 31% while maintaining or improving lesson quality. Belloula (2025) similarly reported that teachers valued AI for automating repetitive tasks, enabling greater focus on creative instruction and student interaction. For Filipino migrant teachers specifically, this efficiency gain carries particular contextual weight, as Borja Martin (2022) documented that Filipino migrant educators face a "double adaptation" burden of simultaneously navigating new curricula, assessment systems, and cultural expectations while developing new professional

competencies. AI tools that reduce lesson preparation time help mitigate this burden, allowing teachers to allocate cognitive resources toward the more complex work of cultural and pedagogical adaptation. The implication is that professional development should focus on AI-augmented design thinking, training teachers to use AI not merely for substitution such as creating a worksheet faster, but for transformation, including generating differentiated problem sets, anticipating student misconceptions, and designing multiple representation pathways.

Eleven of the 12 participants (92%) described how AI tools enabled them to tailor instruction to meet the diverse learning needs present in their classrooms, allowing them to move decisively beyond the one-size-fits-all approach that has long challenged mathematics educators. Ricardo, who teaches at a high school with significant variation in student mathematical preparedness, explained: "AI helps me differentiate instruction by providing varied explanations and practice tailored to students' individual needs. In a typical class, I might have students who are ready for advanced work sitting next to students who are still struggling with prerequisite concepts. With AI tools, I can assign different problem sets to different students based on their current level. The AI adjusts difficulty based on their performance, so each student is working in their zone." Carmen, an eighth-grade mathematics teacher, described how AI expanded her pedagogical imagination: "It gives me better ideas to make my instruction more engaging and relevant. Sometimes I get stuck in a rut, teaching the same concept the same way I've always taught it. AI tools suggest alternative explanations, different representations, connections to real-world contexts I hadn't considered. It's like having a collaborative partner that expands my pedagogical imagination." Elena provided a concrete illustration of AI's diagnostic capabilities: "AI like MagicSchool and Snorkl give feedback to their work in any math problems they were struggling. If a student makes a mistake, the AI doesn't just say 'wrong,' it tries to understand what kind of error they made. Did they misapply the distributive property? Did they forget to invert the fraction? The AI identifies the specific misconception and provides targeted practice to address it."

The high level of agreement on this sub-theme (92%) is consistent with the broader research literature. VanLehn's (2011) meta-analysis demonstrated that intelligent tutoring systems achieve effect sizes comparable to small-group instruction, significantly outperforming traditional whole-class instruction. Cho (2025) analyzed AI-based platforms such as ALEKS and DreamBox and revealed how real-time data analysis enables customized problem sets and explanations that address individual student needs. Vorobyeva (2025) emphasized that effective personalization requires not only adaptive technology but also teachers' pedagogical skill in interpreting AI-generated data and translating it into responsive instruction, a dynamic captured precisely in Ricardo's observation that "the AI gives me data, but I'm the one who decides what to do with it. I know my students, their personalities, their histories, their hopes. The AI doesn't know that. It's a partnership." This finding underscores that AI's personalization capabilities are most educationally powerful when mediated by teacher professional judgment rather than treated as autonomous instructional substitutes.

All 12 participants (100%) observed marked increases in student participation, motivation, and active engagement when AI tools were integrated into instruction, consistently attributing this engagement to the interactive, gamified, and visually rich nature of AI applications. Jose described the transformation in his classroom atmosphere: "The class is more interactive and engaging most especially if we gamify the lesson and activities. Students who used to sit in the back and try to be invisible are now raising their hands, asking questions, wanting to participate. The gamification elements, points, levels, immediate feedback, tap into something that traditional worksheets just don't reach." Maria noted the motivational power of AI-enhanced assignments: "Students are more eager to complete the assignment. When I hand

out a worksheet, there's often a collective groan. When I say we're going to use an AI tool, they actually seem excited. They want to see their progress, they want to beat their previous scores, they want to help each other figure out the challenges." Antonio, who teaches algebra and geometry, highlighted the power of dynamic visualization: "Students could see the results immediately especially in the case when they are supposed to graph equations. When I taught graphing on the board, students would copy what I drew, but they didn't really understand how changing the slope or intercept affected the line. With Desmos and other AI-powered graphing tools, they can manipulate variables and see the graph change in real-time. It's like the concept comes alive for them."

The unanimity of participant responses on engagement (100%) reflects a powerful and consistent pattern in the data. Hwang et al. (2022) conducted a meta-analysis showing that AI-driven gamification in STEM classrooms boosted participation by 28% through real-time feedback and dynamic visualizations. Choi and Baek (2023) found in a randomized trial that adaptive AI activities enhanced time-on-task by fostering discovery-based interaction. Yu's (2024) longitudinal study demonstrated that gamified AI elements significantly raised persistence and enjoyment metrics over an academic year. The engagement documented by participants represents a shift from passive reception to active exploration, consistent with constructivist learning theories that recognize engagement as fueled by experimentation and discovery (Piaget, 1970; Vygotsky, 1978). As Jose reflected, "When students are engaged, my job changes. I'm not spending energy trying to get them to pay attention. I'm spending energy helping them go deeper, answering their questions, challenging their thinking. It's the kind of teaching I went into this profession to do."

Ten of the 12 participants (83%) identified AI's capacity to automate formative assessment and provide real-time, individualized feedback as a significant instructional opportunity. Miguel, who teaches at a high school with large class sizes, explained: "I can digitally see my student's independent performance during the lesson from my screen and interpret it using AI. Before, I would walk around the room, look over shoulders, try to see who was getting it and who was struggling. But I couldn't be everywhere at once. Now, I have a dashboard showing me, in real-time, which students are stuck on which problems, what kinds of errors they're making, how long they're taking. I can intervene precisely where help is needed." Ana connected formative assessment to student motivation: "It improves their score and more engaging because this is more gamified activities. Students get immediate feedback. They don't have to wait until I've graded their papers days later to know if they understand. That instant feedback keeps them in the learning loop. They can correct their mistakes immediately, try again, and experience success right away." Ricardo emphasized the pedagogical value of multiple representations: "AI offers multiple representations of mathematical concepts and immediate feedback. When a student doesn't understand a concept from the symbolic representation, the AI can show them a visual representation, or a verbal explanation, or a real-world example. And the feedback isn't just 'correct' or 'incorrect,' it's specific to what they did and what they might try next."

The strong agreement on this sub-theme (83%) is supported by emerging research. Mousa (2025) demonstrated through a quasi-experimental study that AI-supported formative tools improved student outcomes by 25% via instantaneous, misconception-targeted feedback. Zhao et al. (2025) found that AI analytics dashboards enhanced teachers' instructional agility by identifying common errors in real-time. Mikeska et al. (2025) showed that generative AI could provide unobtrusive competency tracking, supporting continuous assessment cycles. As Miguel's description suggests, AI provides a form of "digital visibility" into student thinking that was previously unavailable, reducing the guesswork in identifying who needs help and on which specific concept. The implication is that teachers require professional development in assessment literacy for AI-rich environments, learning to interpret dashboards and analytics to

inform instructional decisions and to value continuous, process-oriented data streams alongside traditional summative assessments.

Shadows along the path: Exploring challenges in AI-powered integration

The second major theme captures the significant barriers and difficulties that all 12 participants (100%) encountered when integrating AI-powered tools into mathematics instruction. Four sub-themes emerged: Student Over-Reliance and Threats to Academic Integrity, Equity and Access Disparities, Technical and Pedagogical Hurdles, and Need for Balanced Integration and Teacher Role Redefinition.

All 12 participants (100%) expressed significant concern about students' tendency to use AI tools to generate answers without engaging in genuine mathematical thinking. Miguel articulated the disconnect between AI-assisted work and independent understanding: "Students tend to be reliant on the use of AI to complete the tasks. They'll type a problem into an AI tool, get the step-by-step solution, and copy it into their assignment. It looks like they've done the work, but when tested on paper, without AI access, they tend to perform poorly. They haven't developed the skill; they've just gotten good at using the tool." Elena reflected on the challenge of assessing authentic learning: "The downside is that when students are too dependent on these AI-powered tools, it is difficult to tell the quality of their learning. I get beautiful assignments with perfect solutions, but when I sit down with a student one-on-one and ask them to explain their reasoning, they can't. They've become expert copiers but haven't developed mathematical thinking." Carlos described the most concerning manifestation of this challenge: "Abusive use of AI tools, students tend to depend on answers created by these tools and just copy it. It's not just occasional checking of work, it's complete dependence. Some students won't even attempt a problem without immediately reaching for their phone to get the answer. They've lost confidence in their own ability to think mathematically."

The unanimity of concern on this sub-theme (100%) reflects a fundamental pedagogical paradox wherein tools designed to support learning can inadvertently undermine the cognitive struggle essential for mathematical development. Opesemowo and Ndlovu (2024) noted in their critical analysis that overdependence on AI for problem-solving stifles independent reasoning and creativity, hollowing out authentic mathematical proficiency. Michel-Villarreal et al. (2023) identified this dynamic as "cognitive offloading," wherein students outsource thinking to technology rather than developing their own problem-solving capabilities. Elom et al. (2025) found an inverse relationship between AI exposure and ethical engagement through empirical analysis, advocating for AI-resistant assessments and explicit instruction in ethical AI use. This challenge is particularly acute in mathematics education, where procedural fluency and conceptual understanding develop through sustained practice, error correction, and productive struggle processes that AI can short-circuit.

Eleven of the 12 participants (92%) identified significant disparities in students' access to the technological prerequisites for AI integration. Rosa, who teaches at a school serving many low-income families, explained: "Some students don't have devices and internet at home. We have Chromebooks at school, but they can't take them home because there aren't enough for everyone. And even if they could, some don't have internet access at home. So, anything I assign that requires AI tools has to be completed during class time, which limits how much we can integrate these tools." Carmen noted the insufficiency of school resources: "Some students have no Chromebooks... still not enough for everybody. We have carts of Chromebooks that teachers can sign out, but there are more teachers wanting to use them than there are devices. So even when I plan on AI-enhanced lesson, sometimes I can't get the devices I need. It's

frustrating for me and disappointing for students." Ricardo emphasized the qualitative dimension of access disparities: "Students without reliable internet at home or updated personal devices cannot access these tools as easily. Even if they have a device, if it's an old phone with a small screen and slow connection, the experience is completely different from the student with a new laptop and high-speed fiber. The tool might technically be accessible, but it's not equitably accessible."

The near-unanimous concern about equity (92%) reflects what Warschauer (2021) describes as the principle of "digital inclusion," which extends beyond device access to encompass the ability to effectively use technology for meaningful learning. Ahuja and Memon (2025) warned that unmitigated access inequities foster unequal learning outcomes in AI-enhanced mathematics instruction, creating a "digital divide 2.0" where technology benefits already-advantaged students while leaving others further behind. Hlongwane et al. (2025) analyzed AI adoption across socioeconomic contexts and revealed that infrastructure gaps perpetuate disparities unless addressed through systemic interventions such as 1:1 device programs, hotspot lending, and low-tech alternatives. Opesemowo et al. (2024) similarly highlighted how the digital divide limits AI's equitable implementation, particularly in resource-constrained settings.

Ten of the 12 participants (83%) reported encountering various technical and pedagogical difficulties when implementing AI tools, ranging from usability problems to the time-consuming nature of effective integration. Jose described the frustration of non-intuitive tools: "We do have AI-powered tools that are not user friendly. Some platforms are clearly designed by programmers who never asked a teacher what we actually need. The interface is confusing, it's not clear how to assign work or access student data, and troubleshooting problems takes time I don't have. Sometimes I give up on a tool that theoretically would be great because the practical experience of using it is so painful." Maria highlighted the challenge of selecting appropriate content: "It is a challenge to search or choose an activity that is more relatable to the students. There's so much available, literally thousands of AI-generated activities, but not all of them are good quality, not all of them align with my curriculum, not all of them connect to my students' lives and interests. Finding the right tool for the right purpose takes time and judgment." Ricardo noted the hidden time costs of integration: "Managing time has also been a challenge, as setting up tools and guiding students requires additional instructional time. By the time I've logged everyone in, explained how the tool works, troubleshooted the inevitable technical glitches, and gotten students started, we've lost 15 to 20 minutes of instructional time. Over a week, that adds up."

These challenges reflect what Ertmer (1999) described as "first-order barriers," which are external and resource-related obstacles, and "second-order barriers," which are internal and belief-related obstacles to technology integration. Tang (2025) synthesized literature revealing that inadequate infrastructure and professional development create persistent barriers, necessitating curated tool repositories and just-in-time training. Mishra and Koehler (2006) identified technological limitations and educator training deficiencies as key impediments, advocating for TPACK-enhanced preparation programs. For migrant teachers, these hurdles are particularly pronounced as they navigate unfamiliar tools while simultaneously adapting to new educational systems, a dynamic that Borja Martin (2022) described as a "double adaptation" burden that can impede effective integration unless mitigated by comprehensive support systems.

Eleven of the 12 participants (92%) expressed concerns about maintaining pedagogical integrity while incorporating AI tools and preserving their essential instructional role. Jose articulated his philosophy of balanced integration: "It's better to let students learn the skill by hand and just use the AI-powered tool to validate their answer. First, they need to struggle with the mathematics, make mistakes, correct them, develop fluency. Then, after they've done the

work, they can use AI to check their answer, see an alternative approach, or explore extensions. The tool should support learning, not replace the learning process." Rosa emphasized the distinction between procedural and conceptual learning: "AI can accelerate procedural skills but humans need to focus on conceptual understanding. The AI can help students practice computation, but it can't help them understand why the mathematics works the way it does. That's my job, to ask the 'why' questions, to make connections, to help students see the big ideas." Carmen acknowledged her initial apprehension: "I was apprehensive... I feel like the AI tools will spoonfeed my students. When I first heard about AI in education, I was worried that it would make students passive consumers of information rather than active thinkers. I've come to see that AI can be a powerful tool if used thoughtfully, but that initial concern hasn't completely disappeared."

These concerns reflect what Akgun and Greenhow (2021) described as educators negotiating AI's "assistive versus substitutive" roles. Cukurova et al. (2023) demonstrated through mixed-methods analysis that hybrid human-AI models enhance learning outcomes when teachers develop "orchestration skills," the ability to seamlessly integrate AI tools into coherent instructional sequences while preserving their central pedagogical role. Kasneci et al. (2023) advocated for AI literacy training emphasizing supplemental use with clear frameworks for maintaining teacher agency. Molenaar (2023) proposed a framework for hybrid human-AI learning systems that positions teachers as "orchestrators" who manage the interplay between AI-supported individual learning and teacher-facilitated collaborative activities.

Threads of resilience: Weaving strategies to overcome integration challenges

The third major theme captures the adaptive strategies that all 12 participants (100%) developed to navigate the complexities of AI-enhanced instruction. Four sub-themes emerged: Strategic and Selective Use of AI, Promoting Responsible Use and Critical Thinking, Adapting to Equity Gaps through Collaboration and Alternatives, and Self-Directed and Peer-Supported Professional Learning.

All 12 participants (100%) described developing deliberate strategies to limit AI use to specific, pedagogically appropriate contexts while prohibiting or restricting its use in situations where it might undermine learning. Jose articulated his validation-only approach: "Teach the math skill and use the AI-powered tool just to validate their answer. That's my rule. First, students have to engage with the mathematics using their own brains. They work through problems, make mistakes, learn from those mistakes. Only after they've done that work can they use AI to check their answers and see if they were correct. The AI validates their thinking; it doesn't replace it." Miguel described designing tasks that resist AI substitution: "I make sure that not all tasks can be done with the use of AI. Some assignments require students to show their work step-by-step, explain their reasoning in writing, create their own examples, or connect concepts to real-world situations. These are things AI can't do authentically. By varying task types, I ensure that students develop skills they can't outsource." Ricardo advocated for gradual, thoughtful integration: "Start small and use AI as a supportive tool rather than a replacement for instruction. Don't try to transform everything at once. Pick one tool, one unit, one specific purpose. Learn how to use it well in that context before expanding. And always ask yourself: Is this enhancing learning or just making things easier? If it's just easier, maybe reconsider."

The unanimity on this sub-theme (100%) reflects teachers' sophisticated understanding of AI's affordances and limitations. Roll et al. (2022) described this approach as "human-in-the-loop" deployment, which preserves teacher control and pedagogical judgment while

leveraging AI for specific, bounded purposes. Molenaar (2023) advocated for "pedagogical orchestration frameworks" that enable educators to map AI affordances to curriculum phases, distinguishing between formative contexts where AI can support exploration and summative contexts where independent demonstration of learning is required. Kasneci et al. (2023) evidenced that selective, teacher-curated AI applications enhanced learning outcomes without undermining integrity, underscoring the importance of gatekeeping strategies.

Eleven of the 12 participants (92%) described implementing explicit instruction in ethical AI use and requiring students to demonstrate understanding beyond AI-generated outputs. Elena explained her approach: "I tell my students... do not just be after for the AI answers but also look closely, understand how AI break the solution. I model this by projecting AI-generated solutions and asking: Does this make sense? Is there another way to solve it? Could the AI be wrong? I want students to see AI as a tool to learn from, not a shortcut to avoid learning." Ricardo used oral assessment to verify understanding: "I make them explain their reasoning orally. Even if they've used AI to complete an assignment, when they come to me, I ask: Why did you take that step? What does that number represent? How do you know your answer is correct? If they can't explain it, they haven't learned it. The AI might have done the work, but they haven't done the thinking." Ana emphasized the importance of clear expectations: "Set clear expectations for AI use, modeling how to use tools responsibly. At the beginning of the year, we have a whole lesson on AI ethics, when it's appropriate to use AI, when it's not, how to cite AI assistance, what constitutes academic dishonesty. These conversations need to happen explicitly, not just assumed."

This emphasis on AI literacy education within mathematics instruction reflects what Touretzky et al. (2020) called for in their framework for K-12 AI literacy, specifically the critical evaluation of algorithmic outputs. Ng et al. (2022) demonstrated that embedding AI ethics within STEM subjects enhanced students' reasoning skills by 35%. Dollinger et al. (2024) evidenced that mathematics-specific AI literacy rubrics assessing explanation quality improved conceptual mastery.

Ten of the 12 participants (83%) described developing creative workarounds to address technology access disparities. Jose described his collaborative approach: "I let them work with their classmates. If we have limited devices, students work in pairs or small groups. Sometimes this actually works better than individual work. They talk through problems together, explain things to each other, learn from each other's thinking. The collaboration becomes a pedagogical advantage, not just an accommodation." Rosa used simple pairing strategies: "Work in pair. That's my standard approach for AI activities. One device, two students. They have to take turns, discuss their thinking, agree on answers. It builds communication skills and ensures that even without individual devices, everyone is engaged." Ricardo provided multiple pathways to participation: "I provided alternative offline activities, paired students for collaborative work. For students who can't access AI tools at home, I make sure they have paper-based alternatives that accomplish the same learning goals. For in-class work, I structure activities so that AI tools are shared resources, not individual possessions. The goal is learning, not technology use. If technology isn't available, learning still happens."

These adaptive strategies demonstrate what Maanu (2025) described as pedagogical resilience in the face of systemic inequities. De Paula (2024) demonstrated that structured peer collaboration could partially mitigate access disparities by allowing students without individual devices to participate through shared work. Dookurong (2025) found that hybrid collaborative-AI models improved mathematical reasoning equity by 27% when intentionally designed from the lesson outset.

All 12 participants (100%) described pursuing diverse learning pathways to build AI integration competence, combining formal professional development with self-directed exploration and peer collaboration. Jose explained his blended approach: "Explore the tools

and try to practice before introducing it to the students. I spend time in the summer and on weekends just playing with new tools, figuring out what they can do, imagining how I might use them. Then, when I feel confident, I introduce them to students. I also attend PDs whenever they're offered. PDs helped me with being confident in exploring the tools. But the real learning happens when I'm just experimenting on my own." Elena described her self-directed approach: "I learned it myself... I am very explorative and hands on. YouTube is my best friend. If I hear about a new tool, I watch tutorials, read blog posts, join online communities of teachers using the tool. I don't wait for the district to train me. I take responsibility for my own learning." Ricardo emphasized the value of peer learning: "We have a group of Filipino math teachers who meet informally, over lunch, on weekends, in group chats. We share what's working, warn each other about tools that are problematic, help each other troubleshoot. There's a collective wisdom that's more valuable than any formal training I've received."

The unanimity of this sub-theme (100%) reflects what Tan et al. (2025) identified as key features of effective AI-focused professional development: sustained duration, active learning opportunities, coherence with practice, and collective participation. Alreiahi (2025) documented preservice mathematics teachers' success in AI lesson-planning workshops were sandbox environments and peer mentoring fostered confidence. Van Pham (2025) evidenced that distributed professional development ecosystems combining institutional support with personal initiative accelerated equitable AI adoption.

Seeds of transformation: Insights shaping the path to an enhanced future

The fourth major theme synthesizes participants' insights into actionable recommendations for systemic improvement, translating individual experiences into collective guidance for sustainable AI integration. All 12 participants (100%) offered recommendations spanning four interconnected dimensions: Foundational: Ensure Equitable Access and Infrastructure; Pedagogical: Develop AI Literacy and Balanced Integration Guidelines; Professional: Implement Ongoing, Practical Teacher Training; and Cultural: Foster a Community of Responsible Innovation.

All 12 participants (100%) identified basic technology access as a prerequisite for meaningful AI integration and called for systemic investment in infrastructure. Carmen emphasized resource allocation: "More allocation to improve internet connectivity and more Chromebooks. It's that simple and that complicated. We can talk all we want about AI's potential, but if students don't have devices and can't get online, that potential means nothing. The district has to prioritize this, it's not optional anymore, it's essential." Ricardo connected access to equity: "Policymakers should prioritize funding for computers for underprivileged schools. The schools that serve low-income communities often have the oldest technology, the slowest internet, the least technical support. If we don't address this, AI integration will widen the achievement gap rather than closing it. That's not just a technical failure; it's a moral failure." Carlos added a governance dimension: "The IT should try to filter the AI tools to be used by the students and try to control it. Access without guidance is dangerous. We need systems that ensure students are using approved tools appropriately, that protect their privacy, that prevent misuse. Infrastructure isn't just hardware; it's also the policies and systems that govern how technology is used."

These recommendations reflect an understanding of technological infrastructure as a social justice issue. Zhao et al. (2025) found that infrastructure disparities reduced AI efficacy by 40% for underserved students, validating calls for digital equity task forces and maintenance funding. Albalawi (2025) documented mathematics teachers' consensus on policy-driven

hardware allocation and technical filtering as essential governance mechanisms. Chiu (2024) evidenced that comprehensive support systems linking access to pedagogical frameworks yielded 32% greater equity outcomes.

Eleven of the 12 participants (92%) called for clear, curriculum-aligned frameworks governing AI's educational role. Ana articulated the principle of teacher centrality: "AI should only be there to assess work and aid the teachers and not replace them. Any guideline has to start from that premise. AI is a tool, not a teacher. It can help us do our jobs better, but it can't do our jobs for us. If a policy treats AI as a replacement for teachers, it's fundamentally wrong." Elena emphasized comprehensive planning: "Integrating AI... calls for thoughtful policy, ethical guardrails... and strong instructional leadership. We need guidelines that address not just when AI can be used, but how it should be used, what constitutes appropriate use, how we protect student data, how we ensure equity. And these guidelines need to come from teachers, not just be handed down to teachers." Rosa highlighted the need for active dissemination: "More on the dissemination information on the responsible usage of different AI tools. It's not enough to create guidelines, they have to be actively shared, discussed, taught. We need ongoing conversations, not just a document that sits in a folder somewhere." Zhao et al. (2025) revealed through teacher surveys that clear frameworks reduced implementation inconsistency, while Hlongwane et al. (2025) advocated for stakeholder-developed frameworks addressing both technical and ethical dimensions.

All 12 participants (100%) emphasized the need for continuous, job-embedded professional development focused on pedagogical integration rather than merely tool operation. Rosa stated directly: "Provide professional development for teachers to effectively use AI tools. Not just a one-hour workshop where someone shows us cool features, but ongoing support, coaching, PLCs, time to explore and collaborate. This is new for all of us. We need sustained learning, not one-shot training." Ricardo emphasized hands-on practice: "Take advantage of professional development and hands-on practice to build confidence. The best PD I've experienced is when we actually use the tools ourselves, design lessons, get feedback from peers and coaches. Theory is fine, but confidence comes from doing." Maria offered a specific pedagogical recommendation: "Teachers can use AI-powered tools. Students should not be allowed to use AI in answering their assignments. That's a training topic right there, helping teachers think through when AI is appropriate for students and when it's not. These are nuanced decisions that require professional judgment, and we need support in developing that judgment." Copur-Gencturk (2024) demonstrated that just-in-time, personalized feedback in asynchronous professional development improved mathematics teachers' content knowledge and instructional quality. Mortimer and Bell (2025) outlined a three-stage roadmap of discovery, development, and refinement showing that hands-on AI experimentation embedded in pedagogical goals enhanced implementation. Chiu (2025) evidenced that lesson study cycles with AI specialists yielded 29% greater integration success.

Ten of the 12 participants (83%) emphasized the need for cultural shifts that support thoughtful, collaborative, and responsible AI adoption. Ana advised: "Use it responsibly, don't rely too much on AI... this still needs a human intervention. That's the cultural value we need to cultivate. AI as partner, not savior. We should be excited about its possibilities but clear-eyed about its limitations. Technology serves learning, not the other way around." Ricardo recommended gradual implementation: "My advice... is to start small... and always balance technology with opportunities for critical thinking. Don't try to transform everything overnight. Build on successes, learn from failures, and always keep the focus on student thinking. If we create a culture where experimentation is encouraged and reflection is expected, we'll figure this out together." Carlos emphasized professional agency: "Do a research. Do your job. Ask for help if you did the first two. That's my philosophy, take responsibility for your own learning, do the work, but don't suffer in silence. Reach out to colleagues, ask questions, share what

you're learning. A culture of collaboration and mutual support makes all the difference." Hlongwane et al. (2025) demonstrated that schools establishing innovation grants and peer feedback channels experienced 34% higher AI implementation fidelity. Chandler (2024) advocated professional capital frameworks combining decisional clarity with collaborative planning. Van Pham (2025) evidenced that leadership-modeled inquiry cultures accelerated responsible innovation by 27%.

The four major themes of this study are not discrete categories but interconnected dimensions of a unified and dynamic phenomenon. The very features that create opportunities, including AI's efficiency, personalization, engagement, and assessment capabilities, simultaneously generate challenges. Efficiency can enable student over-reliance; personalization can exacerbate access disparities; engagement can mask superficial learning; and real-time assessment can create time costs for teachers already stretched by competing demands. Every challenge documented by participants in turn elicited corresponding coping strategies: student over-reliance led to strategic and selective AI use and the promotion of responsible thinking; equity disparities prompted collaborative workarounds and offline alternatives; and technical and pedagogical hurdles motivated self-directed and peer-supported professional learning. Teachers' individual strategies, when aggregated across all 12 participants, further illuminated the systemic changes needed, including foundational infrastructure investment, clear pedagogical guidelines, and sustained professional development ecosystems. The relationship among themes is not linear but cyclical, as teachers implement coping strategies, encounter new opportunities and challenges, and require ongoing adaptation in response. This dynamic cycle reflects the reality of AI integration as a continuous, evolving process rather than a one-time institutional achievement. These findings collectively and comprehensively address all four research objectives of the study, and the collective insights of the twelve participant teachers culminate in a clear set of evidence-based implications for creating a sustainable, equitable, and pedagogically sound enhancement plan for AI integration in mathematics education, which is detailed in the subsequent chapter as the MERAI-PLAN.

CONCLUSION

This study concludes that the integration of AI-powered tools in mathematics education by Filipino migrant teachers is a complex, paradoxical, and deeply human phenomenon characterized by dynamic tension between transformative opportunities and significant challenges. The findings drawn from the lived experiences of twelve Filipino migrant mathematics teachers in the Jackson Public School District reveal that while AI offers powerful means to enhance teaching efficiency, personalized instruction, student engagement, and formative assessment, its implementation is simultaneously fraught with risks to academic integrity, equity of access, and the preservation of pedagogical autonomy. These tensions are not peripheral concerns but central features of the AI integration experience, and they cannot be resolved through technology alone.

Across all four major themes that emerged from the phenomenological analysis, a consistent and compelling picture emerged of teachers who are not passive recipients of technological change but active, creative, and reflective professionals who navigate complex institutional and pedagogical terrain through deliberate, context-sensitive strategies. The unanimity with which all 12 participants (100%) identified AI-driven efficiency gains, increased student engagement, and real-time assessment capabilities as significant opportunities affirms that AI-powered tools hold genuine transformative potential for

mathematics instruction. At the same time, the equally unanimous concern (100%) regarding student over-reliance and threats to academic integrity, alongside near-unanimous identification of equity and access disparities (92%), technical and pedagogical hurdles (83%), and the need for balanced integration (92%), makes clear that this potential is realized only under specific conditions that current educational systems have not yet reliably created.

The coping strategies developed by participants in response to these challenges further affirm the indispensability of teacher agency in AI integration. The strategic and selective use of AI, endorsed unanimously by all 12 participants (100%), demonstrated that effective integration is neither wholesale adoption nor rejection but a carefully calibrated deployment of technology in service of specific, bounded pedagogical purposes. The promotion of responsible use and critical thinking, practiced by 11 of the 12 participants (92%), revealed that AI literacy education must be explicitly embedded within mathematics instruction rather than assumed or left to students' own ethical judgment. The collaborative and offline adaptations developed by 10 of the 12 participants (83%) to address equity gaps demonstrated pedagogical resilience and ingenuity, while simultaneously underscoring that classroom-level workarounds are not adequate substitutes for systemic infrastructure investment. The self-directed and peer-supported professional learning pursued by all 12 participants (100%) revealed both the extraordinary professional commitment of these educators and the significant gap between the formal support they received and the support they actually required.

The systemic implications identified by participants across the fourth major theme translate these individual and collective experiences into a coherent set of evidence-based recommendations for sustainable AI integration. All 12 participants (100%) identified foundational equitable access to devices, reliable internet connectivity, and technical governance systems as the non-negotiable prerequisite for any meaningful AI integration initiative, recognizing that access without equity is not access at all. Eleven of the 12 participants (92%) called for clear, curriculum-aligned pedagogical guidelines developed with teacher input, communicated actively, and designed to position AI as a scaffold for thinking rather than a substitute for learning. The unanimous call (100%) for continuous, hands-on, job-embedded professional development oriented toward pedagogical integration rather than mere tool operation reflects a sophisticated understanding that sustainable change requires sustained professional learning, not one-time training events. Finally, 10 of the 12 participants (83%) advocated for a broader cultural shift toward responsible innovation, wherein schools cultivate an ethos of experimentation, reflection, collaboration, and shared accountability in relation to AI use.

The predominant conclusion of this study is that for AI to fulfill its transformative potential in mathematics education, it must be guided by approaches that simultaneously prioritize equitable access, preserve the teacher's central instructional role, foster critical thinking over dependency, and are actively supported by continuous, practical, and contextually responsive professional learning systems. The voices of Filipino migrant teachers, positioned at the intersection of multiple educational cultures and navigating the compounding demands of cross-cultural adaptation and technological innovation, offer essential and previously unheard guidance for developing such approaches. Their experiences illuminate both what is at stake and what is possible when teachers engage thoughtfully, critically, and creatively with AI-powered tools in the service of student mathematical learning. These findings provide the empirical and experiential foundation for the MERAI-PLAN enhancement plan presented in the subsequent chapter, which is designed to translate the collective wisdom of these twelve educators into actionable, scalable, and equity-centered institutional strategies for AI integration in mathematics education.

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