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Reimagining mathematics education: Identifying training needs and challenges among public elementary school teacher's post-pandemic

Lislee Valle

College of Education, Arts and Sciences, Danao Campus, Cebu Technological University, Philippines.
Email: lislee.valle@ctu.edu.ph

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ABSTRACT

The sudden shift in the education system during the pandemic and its subsequent evolution during the post-pandemic era have been pivotal in fostering significant educational development and growth. However, this paradigm shift has not been without challenges. This paper aims to investigate the challenges faced by 68 mathematics teachers in four public elementary schools in the Philippines. The respondents were purposively selected to answer the study's instrument. Using a descriptive survey research methodology, this study explored the five domains in teaching mathematics, namely planning lessons, executing lessons, assessment, mathematical knowledge, and using technology tools. This paper revealed that novice, experienced, and highly experienced teachers alike had moderate difficulty enriching mathematical knowledge and utilizing technology in teaching the subject matter. Moreover, teachers with more than five years' experience had moderate difficulty in the five domains of teaching mathematics in the post-pandemic era. This finding emphasizes the widespread impact of the education shift for teachers of all levels of experience. The paper further emphasizes the importance of supporting experienced teachers during this transformative phase of formulating innovative learning activities and adapting to reimagined pedagogical concepts. Consequently, this study underscores the need for additional training interventions to enhance their mathematical knowledge and use of technology as an integral teaching tool.

Contribution/Originality: This study contributes to creating awareness of the challenges encountered by elementary mathematics teachers regarding the planning and execution of lessons, assessment, mathematical knowledge and use of technology tools in the post-pandemic era. This study also provides policy insights tailored to post-pandemic education management.

1. INTRODUCTION

Countries worldwide have recognized the importance of enhancing mathematics education and evolving teaching approaches. Mathematics education has undertaken profound transformations in response to the global pandemic, necessitating an adaptation to the "new normal" in teaching and learning. These changes have been predominantly driven by technological advancements, influencing teaching methodologies and the learning process (Núñez-Canal, De Obesso, & Pérez-Rivero, 2022). Consequently, educators assume roles within this new education paradigm, highlighting the need for teachers to revisit their technological knowledge and update their pedagogical skills to teach effectively post pandemic. The challenges posed by the "new normal" encompass a

delicate equilibrium between technology and pedagogy, requiring a realignment of education content to facilitate learning opportunities that were previously unattainable but can now be delivered effectively within the current education landscape (Rapanta, Botturi, Goodyear, Guàrdia, & Koole, 2021).

In the Philippines and globally, COVID-19 instigated a transformation in various facets of life. The pandemic necessitated a pivotal shift from in-person teaching activities to remote learning interactions facilitated through virtual classrooms or modular instruction. As a result, this paradigm shift within the education system has compelled educators to adapt to a digital era wherein technology assumes a predominant role in every aspect of the teaching process (Nugraha & Prabawanto, 2021), even in the post-pandemic recovery of the country. Moreover, this transformation challenges the education system, especially in basic mathematics education. Thus, this study aims to investigate the challenges faced by mathematics teachers in four public elementary schools in five domains of teaching: planning mathematics lessons, executing mathematics lessons, assessment, mathematical knowledge, and using technology tools. This study purposely selected the respondents with the aim of targeted intervention and professional development efforts to enhance the overall proficiency of mathematics education in the post-pandemic education recovery of the locale.

2. LITERATURE REVIEW

2.1. Mathematics Education Pre-Pandemic

In 2011, the Department of Education (DepEd) launched the Philippine K–12 Education Initiative, which brought about notable changes, especially in mathematics education. This paradigm shift transitioned from the traditional discipline-based model to a more continuous learning method called the spiral approach. Aligned with this, students in Grades 11 and 12 were given the opportunity to explore advanced mathematics subjects related to their chosen specialization. The program's primary goal was to encompass topics previously designated for university courses during Grades 11 and 12, such as precalculus, calculus, and statistics. Additionally, the Mathematics Curriculum Framework act as the cornerstone for mathematics instruction, emphasizing the primary goal of enhancing students' critical thinking and problem-solving abilities in mathematics education. The curriculum also encompasses five distinct content areas that make up mathematics education in the Philippines: Number and Number Sense; Geometry; Patterns and Algebra; Measurement; and Statistics and Probability. The essential skills that must be developed by learners are knowledge and understanding; estimation, computation and problem-solving; visualization and modeling; representation and communication; conjecture, reasoning, proof and decision-making; and application and connection. The national assessment system changed due to the K–12 programs. After Grades 3, 6, 10, and 12, there are four (instead of three) evaluation stages under this new system. Following this, the conventional pen-and-paper test is replaced by an assessment integrating both traditional and authentic evaluation methods. However, the curriculum guidance did not properly define authentic assessment (Southeast Asian Ministers of Education Organization Regional Center for Educational Innovation and Technology (SEAMEO INNOTECH), 2012).

Effective teaching must include planning for the mathematics curriculum (Akyuz, Dixon, & Stephan, 2013). Additionally, how math lessons are presented and how students are assessed significantly impact their learning outcomes (Veldhuis & Van den Heuvel-Panhuizen, 2020). According to Capua (2021), creating and delivering mathematics lessons requires more time from teachers than in previous years. In this context, the teachers are in charge of helping children to develop their mathematical abilities and encouraging a positive learning environment.

On the other hand, enhancing teachers' knowledge of mathematics is vital because it is directly related to improved student achievement (Ball, Thames, & Phelps, 2008). Within the framework of the K–12 curriculum, critical thinking and problem-solving skills play a substantial role in the academe. The notion does not exclude mathematics education, in which teachers' problem-solving and critical thinking skills are imperative and

necessary for instruction as they influence students' overall performance (Salangsang & Subia, 2020; Subia, 2020). However, research by Pentang et al. (2021) found that aspiring elementary teachers in the Northern Philippines lacked adequate problem-solving abilities. These were observed in number sense, measurement, geometry, algebra, and probability when describing circumstances, creating mathematical models, employing strategies to find outcomes, and evaluating, interpreting and reporting final answers.

Furthermore, employing technology as an instructional tool for teaching mathematics is not a novel method. With the rapid developments at the time, the process that began in the 1980s with the usage of calculators has taken on new dimensions (Akkaya, 2016). Distinguished by the emergence of the digital age, incorporating and using technological tools in mathematics education has been acknowledged as both an opportunity and a challenge (Schoenfeld, 2014). This is because of limited and less structured technological training and the insufficient facilities that were in place for technological teaching and learning processes prior to the pandemic. According to various studies, using technology in mathematics instruction improves the quality and sustainability of teaching by positively improving student accomplishment and attitudes toward mathematics (Akkaya, 2016; Diković, 2009; Güven & Karataş, 2020; Kubat, 2018). In the Philippines, DepEd's interest in innovative uses of technology in classroom teaching and learning is well recognized. The DepEd has increased the accessibility of technological training for teachers of several courses, including mathematics. This was a significant event since integration requires teachers to become proficient and skilled in the use of technology when teaching students. As a matter of fact, the worldwide society, as well as neighboring Asian countries, are aggressively pursuing the technology-based approach to education known as Information and Communication Technology (ICT) integration (Cajilig, 2009).

2.2. Mathematics Education During and After the Pandemic

The pandemic's abrupt, rapid, widespread proliferation and the dire consequences of school closures necessitated immediate responses from governments, organizations, and individual educators. The shift from face-to-face to distance learning (either online or modular) occurred during extreme uncertainty and worry, if not trauma, caused by the pandemic. Cahapay (2020) proposed that curricular considerations should encompass education goals, content, pedagogies, and evaluation. However, the unexpected crisis confronting schools worldwide may not have provided a suitable setting for Cahapay's authentic education rethink. For instance, in the contemporary landscape marked by the advent of the "new normal," society has witnessed a significant transformation in education paradigms. These changes are exemplified by the pervasive shift toward digital formats as both a conventional approach and a supplemental tool. In the academe, this transition compels education institutions to not merely adopt but holistically embrace and utilize technology within the domain of teaching and learning processes (Pacheco, 2021). Subsequently, Casinillo, Casinillo, Valenzona, Almonite, and Valenzona (2022) revealed that mathematics students who used distance learning (i.e., online education or modular learning) during the pandemic had a challenging experience. This new learning platform brought several limitations and barriers that students and teachers had difficulty coping with. These barriers and limitations included acquiring the latest technology, good internet signal, and internet data (Pagaran, Loremas, Gultiano, & Etcuban, 2022). Additionally, students experienced difficulty understanding mathematics lessons due to less interaction and proper teacher guidance (Meniano & Tan, 2022).

Hao et al. (2023) presented the experiences of three Filipino mathematics teachers with the disruption in education brought about by the pandemic. It viewed the study community as being disrupted, giving rise to altered teaching activities and some limitations due to unfamiliar settings for some teachers. Despite the existence of ICT integration, pre-pandemic teachers were limited from elaborating on the theoretical environment of mathematical tasks due to their unfamiliarity with the online classroom setup. In response to these changes, teachers holding online classes attempted to communicate with students, restricted the mathematics competencies, and abridged the

assessment strategies to a bare minimum. The move to an online environment exposed several issues, such as the altered spacetime, heavy textualization of concepts, the unresponsiveness of students, and questions on the authenticity of assessment practices (Adedoyin & Soykan, 2023; Maqableh & Alia, 2021; Simamora, De Fretes, Purba, & Pasaribu, 2020). These concerns need a thorough appreciation and response in future initiatives to migrate teaching into online modalities.

According to Alcontin (2021), the varied digital platforms that teachers use and the classroom activities they execute influence their perceptions of digital teaching competence. This indicates that people feel more comfortable instructing while using familiar digital platforms. However, when they are requested to utilize other types of digital platforms to augment their online teaching, they are less confident and hesitant due to their unfamiliarity with the new platforms (Corry & Stella, 2018; Saadati, Giaconi, Chandia, Fuenzalida, & Donoso, 2021). Furthermore, Alcontin (2021) delineated the preferences of Philippine junior high school teachers for teaching manners during the aftermath of the pandemic and found that teachers prefer offline instruction that involves face-to-face interaction in comparison to online instruction. They indicated that offline education is more accurate and successful in terms of material discussion and instructional execution. Furthermore, the results are also consistent with previous studies which demonstrate that the notion of face-to-face interaction in formal classroom settings continues to be the most effective method of instruction (Makruf, Putra, Choiriyah, & Nugroho, 2021; Pei & Wu, 2019; Setyawan, 2019). However, it is credible to contend that the affordances of modern technology have a significant impact on the current education paradigm.

Following this, Askew, Bowie, and Venkat (2019) highlighted that elementary school teachers' mathematical knowledge is one of the most commonly recognized talents in the worldwide community. Educators must comprehend mathematics as a combination of both the style of understanding and the manner of thinking required by students in order for reasoning to occur. Nugraha and Prabawanto (2021) found that elementary math teachers in Indonesia struggled to teach fractions, geometry, ratios and proportion. This challenge stems from the fact that some mathematics concepts are not closely related to the environment of student life. In this situation, the majority of teachers attempted to connect arithmetic knowledge to a specific context, but the strategy was ultimately unsuccessful. Despite the existence of research on the importance of teachers' mathematical knowledge, there is a scarcity of studies on the challenges of teachers enriching their knowledge in mathematics.

3. METHODOLOGY

3.1. Research Context

This research was conducted within the context of four public schools in Cebu Province, Philippines. The study adopted a survey research design as its primary approach. Data collection was executed via the administration of an online questionnaire. The primary focus of this study was to thoroughly analyze and elucidate the challenges confronted by elementary mathematics educators as they contend with the intricate process of post-pandemic education recovery.

3.2. Respondents

A survey was conducted with mathematics teachers at four public elementary schools. They were purposely selected as respondents to determine the challenges they face as public elementary mathematics teachers in post-pandemic education in the Philippines.

Table 1 shows that the total number of respondents is 68 elementary public school teachers, of which 60.29% are experienced with five to ten years of teaching experience, 22.06% are highly experienced with ten years or more of teaching experience, and only 17.65% are novice teachers with less than five years of teaching experience.

Table 1. Profile of the respondents in terms of years of teaching experience.

Years of teaching experience	Total	%
10+ years (Highly experienced)	15	22.06%
5–10 (Experienced)	41	60.29%
Less than 5 years (Novice)	12	17.65%
Total	68	100%

3.3. Research Instrument

The research instrument employed in this study was a questionnaire adapted and refined from the work of Nejem and Muhanna (2013). The original questionnaire developed by these researchers was designed to explore the obstacles faced by mathematics educators in Jordan. For this paper, technology integration was incorporated into the original questionnaire framework. It is noteworthy that technology has emerged as an indispensable tool, particularly during the pandemic, to facilitate effective teaching and learning within the Philippine education landscape, hence the incorporation of the additional questions concerning technology integration. This refined questionnaire encompassed a total of 36 statements organized into distinct domains of mathematics teaching, namely (1) planning for teaching mathematics, (2) execution of mathematics lessons, (3) assessment practices, (4) mathematical knowledge, and (5) technology integration. The modified questionnaire used in this study obtained a Cronbach's alpha of 0.958, a coefficient that indicates that the research tool is reliable (Brown, 2002; Cronbach, 1949; Peterson, 1994).

3.4. Limitations

The challenges that public elementary teachers encounter in mathematics education were investigated by administering a modified questionnaire to include technology integration. Technology was an essential tool for conducting classes during and after the pandemic. Thus, the obtained results are aligned with the content and scope of the questionnaire statements, thereby supporting the validity and appropriateness of the instrument vis-à-vis the research subject matter.

3.5. Statistical Analysis

To address the research inquiries of this study, the Statistical Package for the Social Sciences (SPSS) was utilized as the primary analytical tool. The study employed descriptive statistics such as frequency, percent, mean, and standard deviation to comprehensively and thoroughly characterize the respondents' profiles and the obstacles they encountered in mathematics instruction. Moreover, the research used a one-way analysis of variance (ANOVA) to investigate the statistical significance of the mean differences among three distinct groups of educators (novice, experienced, and highly experienced). Subsequently, the significance of the differences between the pairs of group means was then determined with Tukey's honest significant difference (HSD) test, which allowed for a more in-depth and nuanced analysis of the variations observed within these groups.

4. RESULTS

This section presents the statistical comparison between the responses of the teachers to investigate the challenges of teaching mathematics in public elementary schools in the post-pandemic education recovery.

Table 2 reveals that the respondents experienced slight difficulty during the planning phase for teaching mathematics. Within this domain, respondents experienced moderate difficulty in determining appropriate activities and teaching tools, with a mean score of 2.53 and a standard deviation of 0.70. Likewise, determining the appropriate assessment techniques exhibited a comparable level of difficulty, yielding a mean score of 2.51 and a standard deviation of 0.76. Furthermore, respondents confronted similar difficulty in determining the appropriate time for each teaching activity, indicated by a mean score of 2.72 and a standard deviation of 0.55.

Table 2. Teachers' perceptions of the domain of planning for teaching mathematics.

Indicator	Mean	SD	VD
Analyzing the mathematical content of the lesson to concepts, generalizations, skills, and mathematical problems	2.46	0.73	Slightly difficult
Determining the lesson goals	2.19	0.74	Slightly difficult
Determining the appropriate teaching methods	2.50	0.74	Slightly difficult
Determining the appropriate activities and teaching tools	2.53	0.70	Moderately difficult
Determining the pre-learning of the lesson	2.48	0.74	Slightly difficult
Determining the appropriate assessment techniques	2.51	0.76	Moderately difficult
Determining the appropriate time for each teaching activity	2.72	0.66	Moderately difficult
Aggregate mean	2.49	0.61	Slightly difficult

Note: SD = Standard deviation; VD = Verbal description.
1–1.75 = Not at all difficult; 1.76–2.5 = Slightly difficult; 2.51–3.25 = Moderately difficult; 3.26–4 = Extremely difficult.

Table 3. Teachers' perceptions of the domain of executing mathematics lessons.

Indicator	Mean	SD	VD
Attaining the teaching objectives	2.72	0.69	Moderately difficult
Using computers in teaching mathematics	2.58	0.82	Moderately difficult
Taking care of the individual differences between students	2.75	0.78	Moderately difficult
Executing the planned teaching methods	2.59	0.80	Moderately difficult
Using different patterns of questions during class discussions	2.63	0.81	Moderately difficult
Motivating the students to learn mathematics	2.66	0.75	Moderately difficult
Managing the planned time for each teaching activity	2.76	0.76	Moderately difficult
Introducing the lesson	2.26	0.76	Slightly difficult
Executing the planned activities and teaching tools	2.53	0.84	Moderately difficult
Getting the attention of students toward the new learning	2.49	0.76	Slightly difficult
Aggregate mean	2.60	0.60	Moderately difficult

Note: SD = Standard deviation; VD = Verbal description.
1–1.75 = Not at all difficult; 1.76–2.5 = Slightly difficult; 2.51–3.25 = Moderately difficult; 3.26–4 = Extremely difficult.

Table 3 presents the respondents' perceptions of the domain of executing mathematics lessons. The findings showed that the respondents experienced moderate difficulty in executing the lessons. Within this domain, respondents had a homogeneous experience of moderate difficulty across the multiple facets, including attaining the teaching objectives, using computers in teaching math, taking care of the individual differences between students, executing the planned teaching methods, using different patterns of questions during class discussions, motivating the students to learn mathematics, managing the planned time for each teaching activity, and executing the planned activities and teaching tools.

Table 4. Teachers' perceptions of the domain of assessment.

Indicator	Mean	SD	VD
Analyzing the exam results statistically	2.52	0.65	Moderately difficult
Preparing questions that enhance mathematical thinking	2.49	0.78	Slightly difficult
Preparing the summative test	2.42	0.75	Slightly difficult
Diagnosing the difficulties that the students faced during their mathematics learning	2.52	0.72	Moderately difficult
Diversifying the assessment techniques	2.74	0.68	Moderately difficult
Helping the students to overcome the difficulties of learning mathematics	2.53	0.78	Moderately difficult
Preparing and pursuing the students' homework	2.31	0.67	Slightly difficult
Testing the pre-learning	2.44	0.76	Slightly difficult
Diversifying the test questions between easy and subjective questions	2.56	0.76	Moderately difficult
Aggregate mean	2.50	0.58	Slightly difficult

Note: SD = Standard deviation; VD = Verbal description.
1–1.75 = Not at all difficult; 1.76–2.5 = Slightly difficult; 2.51–3.25 = Moderately difficult; 3.26–4 = Extremely difficult.

Table 4 contains the respondents' answers with respect to their ability to assess students in the field of mathematics. While a predominantly slight level of difficulty was evident in this domain, it is noteworthy that the respondents encountered a moderate level of difficulty in several aspects, such as analyzing the exam results statistically, diagnosing the difficulties that the students faced during their mathematics learning, diversifying the assessment techniques, helping the students to overcome the difficulties of learning math, and diversifying the test questions between easy and subjective questions.

Table 5. Teachers' perceptions of the domain of mathematical knowledge.

Indicator	Mean	SD	VD
Enriching my mathematical knowledge	3.26	0.78	Extremely difficult
Teaching some mathematics subjects	2.74	0.74	Moderately difficult
Explaining some mathematical issues	2.79	0.70	Moderately difficult
Answer the questions and exercises in mathematics textbooks	3.01	0.56	Moderately difficult
Aggregate mean	2.95	0.51	Moderately difficult

Note: SD = Standard deviation; VD = Verbal description.
1–1.75 = Not at all difficult; 1.76–2.5 = Slightly difficult; 2.51–3.25 = Moderately difficult; 3.26–4 = Extremely difficult.

Table 5 provides an insightful overview of the respondents' perceptions of the domain of mathematical knowledge. In this domain, respondents agreed to encountering a moderate level of difficulty. Specifically, they reported experiencing moderate difficulty when it came to teaching some math subjects, explaining some math issues, and answering questions and exercises in math textbooks. Notably, the respondents revealed that they encountered extreme difficulty in enriching their mathematical knowledge.

Table 6. Teachers' perceptions of the domain of using technology tools.

Indicator	Mean	SD	VD
Using the different productivity tools/Apps for teachers	3.02	0.12	Moderately difficult
Using the different mathematics apps/Tools	3.17	0.37	Moderately difficult
Using gamification tools	3.09	0.29	Moderately difficult
Using online assessment tools/Apps	3.09	0.29	Moderately difficult
Using research apps	3.09	0.29	Moderately difficult
Utilizing artificial intelligence (AI) apps that are useful for teaching	3.08	0.26	Moderately difficult
Aggregate mean	3.09	0.23	Moderately difficult

Note: SD = Standard deviation; VD = Verbal description.
1–1.75 = Not at all difficult; 1.76–2.5 = Slightly difficult; 2.51–3.25 = Moderately difficult; 3.26–4 = Extremely difficult.

In Table 6, it is evident that the respondents share a homogenous perspective in encountering a moderate level of difficulty when employing technology tools in the pedagogical process of mathematics education. Their reported challenges extend to various facets of technological integration, encompassing the use of different productivity tools/apps for teachers, different math apps/tools, gamification tools, online assessment tools/apps, research apps, and AI apps for teaching.

Table 7. Levels of difficulty in the domains of mathematics teaching.

Domain	Novice			Experienced			Highly experienced		
	Mean	SD	Verbal description	Mean	SD	Verbal description	Mean	SD	Verbal description
Planning for teaching mathematics	2.43	0.63	Slightly difficult	3.00	0.00	Moderately difficult	2.98	0.15	Moderately difficult
Executing mathematics lessons	2.53	0.63	Slightly difficult	2.70	0.20	Moderately difficult	2.77	0.25	Moderately difficult

Domain	Novice			Experienced			Highly experienced		
	Mean	SD	Verbal description	Mean	SD	Verbal description	Mean	SD	Verbal description
Assessment	2.49	0.61	Slightly difficult	2.67	0.42	Moderately difficult	2.89	0.25	Moderately difficult
Mathematical knowledge	2.94	0.53	Moderately difficult	2.95	0.22	Moderately difficult	2.91	0.91	Moderately difficult
Using technology tools	3.08	0.21	Moderately difficult	3.25	0.50	Moderately difficult	3.03	0.09	Moderately difficult
Overall	2.69	0.43	Moderately difficult	2.91	0.19	Moderately difficult	2.92	0.10	Moderately difficult

Note: SD = Standard deviation; VD = Verbal description.
1–1.75 = Not at all difficult; 1.76–2.5 = Slightly difficult; 2.51–3.25 = Moderately difficult; 3.26–4 = Extremely difficult.

Table 7 reveals insights into the proficiency levels of elementary teachers across various domains of their professional practice. Notably, elementary educators, regardless of their experience level (i.e., novice, experienced, or highly experienced) exhibited a degree of difficulty when utilizing technology tools in their teaching endeavors. This observation underscores a consistent difficulty among elementary teachers in effectively incorporating technological resources into their pedagogical practices, as reflected in a multitude of prior studies. Furthermore, the domain of mathematical knowledge presented a distinct pattern, as all categories of elementary teachers reported encountering a moderate level of difficulty in this area. This shared experience highlights a notable challenge in mathematics content expertise within elementary teaching.

Remarkably, a nuanced distinction emerged among experienced and highly experienced public elementary teachers, as they reported experiencing moderate difficulty in various key domains, including planning for teaching mathematics, executing mathematics lessons, and conducting assessments. In contrast, novice teachers with fewer than five years of teaching experience indicated a slightly lower level of difficulty in these domains.

Table 8. Mean comparisons between the ratings of the domains of mathematics teaching in terms of years of teaching.

Domain	F	P-value	Comparison groups	Post hoc p-value
Planning for teaching mathematics	37.203	0.00**	1 vs 2	0.00**
			1 vs 3	0.021*
			2 vs 3	0.00**
Executing mathematics lessons	23.401	0.00**	1 vs 2	0.00**
			1 vs 3	0.00**
Assessment	13.443	0.00**	2 vs 3	0.00**
			1 vs 3	0.01*
Mathematical knowledge	2.183	0.147		
Using technology tools	31.778	0.00**	1 vs 3	0.00**
			2 vs 3	0.00**

Note: 1 = Novice, 2 = Experienced, 3 = Highly experienced.
* indicates a significant statistical difference with $p < 0.05$; ** indicates a significant statistical difference with $p < 0.01$

Table 8 presents a statistical comparison of the means across the three classifications of teachers (i.e., novice, experienced, and highly experienced). The domains of mathematics teaching were analyzed using analysis of variance, and the results showed significant differences among the means. A subsequent post hoc analysis revealed nine specific pairwise comparisons that are statistically significantly different from each other.

5. DISCUSSION AND IMPLICATION

This study investigated the challenges faced by math teachers in four public elementary schools in the Philippines' post-pandemic education recovery. The COVID-19 pandemic accelerated the integration of technology into education, making it an integral part of teaching and learning. This shift brought opportunities and challenges for educators (UNESCO, 2020). Teachers in the Philippines encountered obstacles adjusting to technology-

enhanced mathematics teaching because internet connection and digital infrastructure is not widely available (UNESCO, 2020). The study's findings highlighted five domains where targeted interventions and professional development efforts are necessary to improve learners' overall mathematics proficiency. These domains are planning for mathematics teaching, lesson execution, assessment, mathematical knowledge, and use of technology tools. Despite the emphasis that teachers are the ultimate decision makers in the classroom and are responsible for choosing the best instructional techniques and strategies, curriculum content and assessment tasks (Little, 2003), the results revealed that teachers still experienced some difficulty in planning for teaching, especially for a new curriculum. These findings are supported by Palobo et al. (2018), who found that teachers faced several difficulties in lesson planning for a new curriculum, specifically when developing lesson competencies, methods, assessments, and learning tools. However, existing research shows that pre-service teachers experience challenges in executing mathematics lessons; this is contrary to this study's findings that experienced and highly experienced teachers had moderate difficulty in executing mathematics lessons. In a study by Colby and Stapleton (2006), pre-service teachers have difficulty executing lesson plans, while Alanazi (2019) highlighted that pre-service teachers encountered particular challenges in time management while executing lessons. In addition to challenges that the teachers experienced in the domain of assessment, Buabeng, Atingane, and Amoako (2019) highlighted other challenges that frustrate classroom assessment practices, including inadequate assessment materials, teachers' high workload, and students' poor attendance.

The findings show that public elementary mathematics teachers experienced moderate difficulty enhancing their mathematical knowledge and adopting technology tools in mathematics education. Kim, Kim, Lee, Spector, and DeMeester (2013) suggested that a teacher's proficiency in mathematics significantly influences their ability to incorporate technology into their teaching methods. Consequently, it can be inferred that educators' proficiency, expertise, and teaching experience during the pandemic will play a vital role in shaping how they integrate technology into mathematics instruction when in-person teaching returns after the pandemic. Hence, as teachers faced moderate challenges in enhancing their mathematical expertise during the pandemic, they will likely encounter obstacles in utilizing and merging technology tools into math education during the post-pandemic education recovery. This resonates with the need for targeted professional development programs. In various existing research, mathematical knowledge is considered an essential element for effective mathematics education (Copur-Gencturk, 2015; Hine, 2015; Rowland & Ruthven, 2010); however, there is a dearth of studies on the challenges encountered by teachers in their mathematical knowledge to support the findings. On the other hand, Stein, Gurevich, and Gorev (2020) pointed out that teachers believed that integrating technology into their teaching facilitates students' learning and understanding. They are open to using digital tools for teaching and learning; however, school management support is integral to successful technology integration.

The significant differences in the respondents' opinions across different domains and career stages highlight the importance of considering teachers' varying needs and experiences. According to Ingersoll and Strong (2011), novice teachers may require more foundational support in areas such as planning for mathematics teaching, while experienced teachers may benefit from advanced training in technology integration. However, the study's results reveal that novice teachers only have slight difficulty planning, executing and assessing mathematics lessons, while experienced and highly experienced teachers have moderate difficulty in these domains. This could be attributed to several factors, such as pre-service training in teacher education institutions (Corcoran & O'Flaherty, 2018), seminars attended (Abarro, 2018), and workload (Nadeem et al., 2011).

In addition to Ingersoll and Strong (2011), the results show that novice, experienced, and highly experienced teachers need advanced training in technology integration and enriching mathematical knowledge. This is because the current education paradigm has incorporated technological tools into teaching and learning. Hence, the overwhelming number of technological tools to be integrated into the academe necessitates teachers to undergo extensive training in utilizing technology in teaching (Chang, Arisanti, Octoyuda, & Insan, 2022; Hakim, 2020;

Williamson, Eynon, & Potter, 2020). Lastly, this paper illustrates that highly experienced teachers experienced moderate difficulty in the five domains of teaching mathematics despite their substantial background in teaching. Similarly, this supports the claims of Garet, Porter, Desimone, Birman, and Yoon (2001), who posited that highly experienced teachers may have rich insights into teaching to contribute to the new generation of teachers but could also benefit from staying updated on emerging pedagogical and technological trends. Research suggests that sustained enhancement training for professional development can positively impact teachers' mathematical knowledge, technological and pedagogical practices (Buczynski & Hansen, 2010).

6. CONCLUSION

The data and results indicate that the respondents need training to enhance their mathematical knowledge and use of technological tools.

The shift in the education system during and after the pandemic is considered by many as a significant change in the country's education system. While this change offers development and benefits in reinforcing the use of technology in mathematical education throughout different grade levels, it presents unique challenges for teachers. Experienced and highly experienced teachers who are masters of in-person instruction had to adjust to technology-enhanced mathematics education and formulate new learning activities and learning/relearning concepts.

7. RECOMMENDATIONS AND SUGGESTIONS

Implementing the post-pandemic education recovery system has introduced technology at every grade of mathematics education. It requires novice, experienced, and highly experienced teachers to adapt their teaching approaches and mathematical knowledge. These teachers, who were masters of the pre-pandemic in-person interaction, were tasked with aligning their expertise with the requirements of technology-enhanced mathematics education. Embracing this change meant adjusting their instructional strategies and formulating new and engaging learning activities aligned with technology-enhanced objectives. In accordance with this, the paper's findings highlight the need for additional training to enhance their mathematical knowledge and use of technology as an integral teaching tool. Additionally, it is recommended that the teachers be given training to enhance their mathematical, pedagogical, and technological knowledge. For instance, administrators may initiate special training to improve teachers' competence in teaching mathematics in post-pandemic education recovery. It is important to emphasize that these training programs will be conducted by experts who specialize in integrating technology into mathematics teaching. This specialized training will empower teachers to effectively utilize technology to enhance their mathematical capabilities, develop valuable instructional materials, teach the subject effectively, and manage technology-integrated math classes. Additionally, the training content can incorporate techno-pedagogical competencies based on theoretical frameworks, such as Technological Pedagogical Content Knowledge (TPACK), which provide a theoretical foundation for the process of integrating technology into the classroom. Consequently, the primary goal of these training initiatives should be to equip educators with the essential knowledge, skills, and attitude necessary to enhance their mathematical proficiency, refine their teaching methods, and improve their technological competence.

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Transparency: The author states that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
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