Southeast Asia Mathematics Education Journal
Volume 13, No 1 (2023)

Mathematics Teachers' Levels of ICT Expertise and Use and Their Beliefs about ICT Integration and Students' Problem-Solving Skills

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Abstract

This study aimed to determine the relationship between the secondary Mathematics teachers' level of ICT expertise, level of ICT use and students' problem-solving skills. It employed two data collection tools: the Mathematics Teachers' Survey Questionnaire (MTSQ) and the Mathematics Assessment on Problem Solving (MAPS). The samples encompassed 40 Grade 7 Mathematics teachers and 2,439 Grade 7 students from three school divisions in Ilocos Norte, Philippines. The results demonstrated that teachers are highly competent in basic ICT skills and applications, and they have positive beliefs about the use of ICT in teaching. However, because preparing ICT-enriched instruction takes more time, they only use ICT in teaching once or twice a week on average. According to the study's findings, teachers who are younger and have attended more ICT-related training are better equipped with ICT skills, use ICT in classroom instruction more frequently, and have a better disposition towards ICT integration in teaching. The study further discovered that when teachers believe they have a high level of ICT expertise, they are more likely to use ICT in their classrooms. Similarly, when teachers are more knowledgeable about using ICT, they are more inclined to support ICT integration in the classroom. Notably, the study reveals that students' problem-solving skills are significantly related to teachers' level of expertise, level of ICT use, and their beliefs about ICT integration.

Keywords: ICT expertise, ICT use, ICT beliefs, Problem solving skills, Mathematics education

Introduction

Information and Communication Technologies or ICT are now ubiquitous in all aspects of everyday life. They have rapidly become one of the fundamental building blocks of modern civilization, and many countries now consider understanding ICT and mastering the fundamental skills and concepts of ICT to be part of the core of education, alongside reading, writing, and arithmetic (Khvilon & Patru, 2002).

ICTs have had an impact on research, teaching, and learning in the subject of education (Yusuf, 2005). Previous research into teachers' use of ICTs identified staff development as one of the contributing variables to using ICTs effectively in the classroom. Teachers and students recognize ICT skills and then apply them in the teaching and learning process in response to global educational problems by investigating and implementing ICT by employing effective approaches (Buyong, 2002). Not only do individuals and schools value the role of technology; governments increasingly recognize it as an important component of education reform and devote significant resources to it (Bulman & Fairlie, 2016).

Many countries have been encouraging the use of technology in various subjects, including mathematics, over the last three decades (Alhejoj, 2020). Math education requires strategies for problem solving. Teaching students how to solve problems has always been a challenge for

educators. Thus, integration of ICT plays a significant role in improving students' problem-solving skills. A substantial body of research literature has demonstrated that ICT can assist children in developing higher-order mathematical thinking and problem-solving skills (Drigas & Karyotaki, 2016; Leite, 2019; Parno et al., 2021).

However, educational systems face new challenges in the twenty-first century. As a result, it is critical to develop a workforce capable of serving both the country and the rest of the world. Information is essential in the creation of knowledge, and a nation's capacity for knowledge acquisition and application will determine its future strength. The educational system should be capable of developing students' critical thinking abilities, internalization of moral principles, improved communication skills, and improved information-seeking abilities.

According to the National Council of Teachers of Mathematics (NCTM), effective teachers maximize the potential of technology to develop students' understanding, stimulate their interest, and increase their mathematical proficiency (NCTM, 2015). As a result, the main issue is how teachers integrate technology, the necessary knowledge, and their motivation or challenges to do so.

Consequently, today's math teachers must plan and administer best practices for ICT to engage students in their learning, allow them to develop critical thinking as well as enhance their math skills to construct, and expand (Niess, 2013). Technological, Pedagogical and Content Knowledge (TPACK) is an elastic framework for technology integration that involves three types of knowledge that instructors must connect in order for technology integration to be successful in education. TPACK is regarded as a leading tool or map for understanding teachers' knowledge of how to effectively integrate ICT in their classrooms and for assisting in the development of this knowledge as well as ICT practice (Alhejoj, 2020).

Given these digital world demands and ICT-related studies and frameworks, it is critical for a developing country like the Philippines to ensure that the next generation of Filipino graduates gains a broader range of skills and that all Filipinos have equal access to and benefit from the digital economy. The Philippine government has been working to reform the educational system since 2011. The Department of Education's (DepEd) K-12 educational reform program, in particular, aims to align Philippine education with global standards, aligning its vision with that of international education organizations and agencies. Enhancing the mathematical skills of Filipino students thus requires a strategic focus on teachers. Compelling evidence from international experience indicates that teachers who possess strong content knowledge are the main determining factor behind high-performing students (Glewwe et al., 2011).

Previous research, however, has demonstrated that ICT integration is a complex phenomenon (Mackey & Mills, 2002; Ng et al., 2010) and that technology or computer use among teachers is a difficult process (Chen, 2010). Many mathematics teachers are still struggling to implement ICTs as an instructional teaching-learning methodology (Kaleli-Yilmaz, 2015). Within years of implementing various technology initiatives in educational systems, Ismail et al. (2007) reported that teachers' level of technology integration was still low. Evidence from research has consistently shown that school teachers have not advanced to higher levels of ICT use and expertise, which is detrimental to the effective integration of ICT in teaching practice (Castillo, 2007).

ICT use in schools has become a focus of educational research (Eickelmann, 2011). Problem-solving skills acquired through ICT use are similar to those required for successful mathematical competence in secondary schools (Senkbeil & Wittwer, 2008).

However, it is critical to comprehend how ICT use can influence learning and achievement (Voogt, 2008), which is not yet clear. Furthermore, little research has been conducted on how mathematics teachers integrate technology into their classroom instruction (Bray & Tangney, 2017). While various studies have been conducted to determine the impact of ICT on teaching and learning Math, it remains to be determined whether the extent of ICT use by teachers, as well as their levels of ICT expertise and beliefs about ICT integration, are predictors of students' problem-solving skills.

In this study, ICT use in general and at school, particularly for mathematics learning, is incorporated into an analysis to obtain a comprehensive picture of the relationship between teachers' levels of ICT expertise and use, their beliefs about ICT integration, and students' problem-solving skills.

The objective of this study was to determine the relationship between Mathematics teachers' levels of ICT expertise and use and their beliefs about ICT integration and students' problem-solving skills. This study specifically sought solutions to the following problems:

1. What are the socio-demographic characteristics of mathematics teachers in terms of:
   a. age;
   b. number of years teaching mathematics;
   c. educational attainment; and
   d. ICT-related training attended?
2. What is the teachers' level of ICT expertise in the classroom?
3. What is the teachers' level of ICT use in the teaching and learning process?
4. What are the teachers' beliefs about ICT integration?
5. Is there a significant relationship between each of the socio-demographic characteristics of the mathematics teachers and their:
   a. level of ICT expertise;
   b. level of ICT use; and
   c. beliefs about ICT integration?
6. Is there a significant relationship between Mathematics teachers':
   a. level of ICT expertise and use;
   b. level of ICT expertise and their beliefs about ICT integration; and
   c. level of ICT use and their beliefs about ICT integration?
7. What is the student's level of problem-solving skills in Mathematics?
8. Is there a significant relationship between the student's problem-solving skills and teachers':
   a. level of ICT expertise;
   b. level of ICT use; and
   c. beliefs about ICT integration?

Methods

Research Design

A descriptive-correlational research design was employed in this study. It is descriptive because it describes the teachers' socio-demographic profile, level of ICT expertise and use, and beliefs about ICT integration. It is correlational as it established possible relationships among teachers' socio-demographic profiles, their level of ICT expertise and use, their beliefs about ICT integration, and students' problem-solving skills.

Population and Sampling Procedures

The population of the study involved forty (40) Grade 7 Mathematics teachers from 25 public secondary schools in the City Schools Division of Laoag and Batac and Schools Division of Ilocos Norte; and 2439 Grade 7 students who were selected through cluster sampling.

Research Instruments

Data from this research were obtained through two instruments, encompassing Mathematics Teacher's Survey Questionnaire (MTSQ) and Mathematical Assessment on Problem Solving (MAPS).

The Mathematics Teacher's Survey Questionnaire (MTSQ) was divided into four sections: the first section collected socio-demographic information from the teacher-respondents, involving age, number of years teaching Mathematics, educational attainment, and participation in ICT-related training. The second section of the questionnaire, which assesses teachers' level of ICT expertise, was adapted from the questionnaire used by Alharbi (2014) in his study on the use of ICT in secondary school teaching in Kuwait. The third section of the questionnaire inquired about teachers' use of ICT in the classroom. Items in this portion were culled from the combined survey instruments of Umar and Hassan (2015) and Kamau (2014). The instruments were modified to update several technological devices that were already obsolete in the teaching and learning process. The fourth section of the questionnaire encompassed a series of statements that assessed teachers' beliefs about ICT integration. These statements were drawn from several studies (Alharbi, 2014; Kamau, 2014; and Moila, 2006) on teachers' beliefs about ICT integration. A group of Mathematics experts validated the instrument by checking the completeness of the items and whether it could provide answers to the problems raised in the study. The Cronbach alpha was calculated to be 0.826, indicating that the instrument was reliable for the study.

The Mathematical Assessment on Problem Solving (MAPS) is a 50-item teacher-created test with 40 multiple-choice items and 10 constructed-response items. The test items were employed to assess the three problem-solving cognitive domains used in the 2015 TIMSS: a) knowing facts, procedures, and concepts; b) applying knowledge and understanding; and c) reasoning. This teacher-created test was validated in two stages. The first phase involved a committee of Math content experts, including teachers and administrators, evaluating all questions to ensure their appropriateness for measuring the problem-solving skills of Grade 7 Mathematics students. The second phase involved the validation of the pre-identified cognitive domain of each item by another set of Math experts in the locality. To evaluate students'

answers to each problem in the given test, the 2015 TIMSS scoring guide was utilized. The questions covered Grade 7 Mathematics topics such as number sense (rational numbers), number sense (exponents, powers, and ratios), and algebra.

Data Analysis

The research data was interpreted and analyzed using frequency and percentage distributions, means, and Pearson's r. The first method is used for evaluating the information on the respondents' profiles. The weighted means were computed and interpreted to describe the teacher's level of ICT expertise using the following range of values with corresponding descriptive interpretations.

Range of Means	*Descriptive Interpretation*
4.18 – 5.00	Expert
3.34 – 4.17	Advanced
2,51 – 3.33	Average
1.68 – 2.50	Beginner
0.85 – 1.67	Newcomer
0.00 – 0.84	Unfamiliar

Similarly, the weighted means of teachers' ICT use were calculated and interpreted using the following range of values and descriptive interpretation.

Range of Means	*Descriptive Interpretation*
2.26 – 3.00	High
1.51 – 2.25	Moderate
0.76 – 1.50	Low
0.00 – 0.75	No Integration

The weighted means for the teacher's beliefs about ICT integration, on the other hand, were interpreted using the following range of values with corresponding descriptive interpretation:

Range of Means	*Descriptive Interpretation*
4.21 – 5.00	Very Highly Favorable
3.41 – 4.20	Highly Favorable
2.61 – 3.40	Moderately favorable
1.81 – 2.60	Slightly Favorable
1.00 – 1.80	Not Favorable

The students' problem-solving skills were determined using their problem-solving test scores, and they were categorized by employing the following scale range with their corresponding level of competency.

Range of Means	*Descriptive Interpretation*
46 – 60	Advanced
31 – 45	High
16 – 30	Intermediate
0 – 15	Low

Pearson's r was employed to examine the relationship between the teacher's sociodemographic characteristics, level of ICT expertise, level of ICT use, beliefs about ICT integration, and problem-solving skills.

Results and Discussion

Teachers' Socio-demographic Characteristics

Generally, teachers are young both in age ($\bar{x}$ = 35.08) and teaching experience ($\bar{x}$ = 9.98). The majority of teachers (21 or 52.50% of the total) are BS graduates with master's degrees. The majority of them (21 or 52.50%) have yet to participate in any ICT-related training. This is consistent with a Walet (2014) survey, which revealed that few teachers are trained in countries where ICT is scarce, such as the Philippines, Myanmar, and Kyrgyzstan. In his research, Bonifacio (2013) discovered that public schools typically send only a few teachers to computer literacy training.

Teachers' Level of ICT Expertise

Generally, teachers perceived themselves to be highly competent in the Basic ICT skills and applications required in the integration of ICT in teaching Mathematics.

Table 1

Mathematics Teachers' Level of ICT Expertise

ICT Skill	Mean	Descriptive Interpretation
1. The fundamentals of operating a personal computer/laptop (keyboard, mouse, turning on, shutting down, and so on)	4.33	Expert
2. Managing files (moving, deleting, copying files, etc.)	4.25	Expert
3. Utilizing a Word processor (Microsoft Word or equivalent software)	4.13	Advanced
4. Utilizing a spreadsheet processor (Microsoft Excel or equivalent software)	3.78	Advanced
5. Creating presentations by combining files from various sources (such as sound or video files)	3.38	Advanced
6. Utilizing presentation software (Microsoft PowerPoint or equivalent software)	3.63	Advanced
7. Manipulating LCD projectors during the presentation of topics	3.63	Advanced
8. Manipulating television and/or DVD players during the presentation of topics	3.63	Advanced
9. Editing pictures or raw videos	3.15	Average
10. Utilizing digital cameras	3.55	Advanced
11. Internet browsing on the computer	4.05	Advanced
12. Internet browsing on the mobile phone	3.90	Advanced
13. Searching for information on the internet	4.05	Advanced
14. Downloading files from the Internet	3.90	Advanced
15. Employing email (reading and sending emails)	3.68	Advanced
16. Utilizing different social media sites (Facebook, Twitter, etc.)	3.90	Advanced
17. Creating/Using Chatgroups and Forums in teaching (Facebook Group, Twitter, etc.)	3.18	Average
18. Publishing a personal blog (Blogspot, WordPress, etc.)	2.35	Beginner

19. Designing a web page or personal site	1.88	Beginner
20. Producing a learning software	1.80	Beginner
Overall Mean	3.51	Advanced

Legend: Range of Means	Descriptive Interpretation
4.18 – 5.00	Expert
3.34 – 4.17	Advanced
2.51 – 3.33	Average
1.69 – 2.50	Beginner
0.85 – 1.67	Newcomer
0.00 – 0.84	Unfamiliar

The obtained composite mean of 3.51 is equivalent to a descriptive rating of advanced level. Teachers are most experts in basic operations of personal computers ($\overline{x}$ = 4.33) and managing files ($\overline{x}$ = 4.25). This is similar to the findings of del Rosario (2015), who discovered that teachers use their personal computers in the classroom regularly and are implementing creative uses of technology such as data management and presentation. However, teachers scored the lowest in designing web pages ($\overline{x}$ = 1.88) or personal sites and producing learning software ($\overline{x}$ =1.80) which suggests that they have to upgrade their knowledge and skills in more advanced ICT applications. Several studies have revealed a need for teachers to improve their ICT knowledge and skills (McKenna, 2015; Park, 2016), and additional improvements are required to enrich the effectiveness of their ICT utilization by identifying supplementary information they considered when planning instructional experiences (Browne, 2019).

Teachers' Level of ICT Use

The perceived levels of ICT use were determined by investigating teaching and learning material, generating a lesson plan, creating activity sheets, teaching mathematical concepts, and assessing students' performance.

The component preparing activity sheets recorded the highest level of use among teachers ($\overline{x}$ = 2.19) followed by searching for teaching and learning material ($\overline{x}$ = 2.02), preparing a lesson plan ($\overline{x}$ = 1.98), and teaching mathematical concepts ($\overline{x}$ = 1.81). Teachers use ICT least frequently in evaluating students' performance ($\overline{x}$ = 1.60). Overall, teachers perceived themselves to be moderate users ($\overline{x}$ = 1.87) of ICT that is, They only use ICT in the classroom once or twice a week. According to Kiru (2018), teachers in various countries used ICT in mathematics instruction with varying degrees of frequency. Given the likelihood of differences between countries in aspects such as the role of ICT in teaching and learning or government initiatives in various countries, such differences in teachers' ICT use are plausible (Kiru, 2018).

Table 2

Mathematics Teachers' Level of ICT Use

ICT in Classroom Activities	Mean	Descriptive Interpretation
I. Searching for Teaching and Learning Material	2.02	Moderate
II. Preparing a Lesson Plan	1.98	Moderate
III. Preparing Activity Sheets/Worksheets	2.19	Moderate
IV. Teaching Mathematical Concepts	1.81	Moderate

V. Evaluating Students' Performance	1.60	Moderate
Overall Mean	1.87	Moderate

Legend: Range of Means	Descriptive Interpretation	
2.26 – 3.00	High	Three to five times a week
1.51 – 2.25	Moderate	Once or twice a week
0.76 – 1.50	Low	Once or twice a month
0.00 – 0.75	No Integration	No integration

Teachers' Beliefs about ICT Integration

Generally, teachers organized positive beliefs about the use of ICTs in education ($\overline{x}$ = 3.92). They highly favor the benefits of utilizing ICT in enhancing classroom instruction and developing students' knowledge and skills.

Table 3
Mathematics Teachers' Beliefs about ICT Integration.

Statement on ICT Integration	Mean	Descriptive Interpretation
1. The use of ICT makes my teaching more interesting	4.25	Very Highly Favorable
2. The use of ICT makes my preparation of lessons faster	4.03	Highly Favorable
3. The use of ICT decreases students' motivation*	1.95	Slightly Favorable
4. The use of ICT improves my classroom management as a teacher	4.03	Highly Favorable
5. The use of ICT motivates my students to get more involved in learning activities	4.18	Highly Favorable
6. The use of ICT promotes the development of interpersonal skills of students (e.g., ability to relate or work with others)	4.08	Highly Favorable
7. The use of ICT promotes the development of communication skills of students (e.g., writing and explaining mathematical solutions)	3.85	Highly Favorable
8. The use of ICT helps accommodate my students' personal learning styles	3.93	Highly Favorable
9. The use of ICT encourages my students to develop their problem-solving skills	3.85	Highly Favorable
10. ICT often prevents teaching because of interruption in work or software*	2.58	Slightly Favorable
11. The use of ICT has brought positive impact on my students' learning	4.08	Highly Favorable
12. The use of ICT improves my students' test and exams results	3.90	Highly Favorable
13. The use of ICT makes it more difficult to control the class*	2.10	Slightly Favorable
14. The use of ICT promotes collaborative learning among my students	4.00	Highly Favorable
15. The use of ICT gives the teachers the opportunity to be learning facilitators instead of information providers	4.00	Highly Favorable
16. The use of ICT makes teachers feel more competent as educators	4.05	Highly Favorable
17. The use of ICT is difficult to use while teaching mathematics*	2.45	Slightly Favorable

18. The use of ICT creates a platform for me to communicate with other teachers sharing common problems	3.85	Highly Favorable
19. ICT-integrated instruction is more effective than the traditional method of instruction	3.73	Highly Favorable
20. The use of ICT gives many problems in managing classrooms that use ICT*	2.33	Slightly Favorable
Overall Mean	3.56	Highly Favorable

*Negative Statements

Legend: Range of Means	**Descriptive Interpretation**
4.21 – 5.00	Very Highly Favorable
3.41 – 4.20	Highly Favorable
2.61 – 3.40	Moderately Favorable
1.81 – 2.60	Slightly Favorable
1.00 – 1.80	Not Favorable

Specifically, they favored the highest that ICT makes teaching more interesting ($\overline{x}$= 4.25) while they disagreed the strongest that ICT decrease students' motivation ($\overline{x}$ = 1.95). This finding is consistent with the findings of Umar and Hassan (2015), who discovered that teachers generally agree that the use of ICT has improved their classroom teaching practices. Furthermore, Andre (2020) revealed that teachers have a positive attitude toward ICT integration and are willing to learn new ICT skills.

Level of Students' Problem-solving Skills

Except for 357 students, all were at least intermediate in problem solving. There were 250 students who attained Advanced level, 764 students attained High level, and 1068 students attained Intermediate level. However, with a mean of 29.50 and a standard deviation of 9.09, the overall level of problem solving skills was intermediate.

Table 4
Distribution of Students According to Their Level of Problem-solving Skills

Range of Percentage Score	Level of Achievement	*f*	Percentage
46 – 60	Advanced	250	10.25
31 – 45	High	764	31.32
16 – 30	Intermediate	1068	43.79
0 – 15	Low	357	14.64
Total		2439	100.00
Mean		29.50	
Overall Level of Problem-Solving Skills		Intermediate	

In general, the findings indicate that students can apply basic mathematical knowledge in simple situations, but they require significant effort to formulate, grapple with, and solve complex problems. As a result, teachers must continue to teach students how to apply their understanding and knowledge to a wide range of relatively complicated but contextualized problems.

Correlation Analysis of Mathematics Teachers' Socio-demographic Characteristics and Their Level of ICT Expertise, Level of Use, and Beliefs about ICT Integration.

The teachers' level of ICT expertise is significantly related at the 0.01 level of significance with their age (r = -0.409) and number of years teaching mathematics (r = -0.449). This suggests that younger math teachers have a higher level of ICT expertise than older ones. Similarly, teachers who are relatively new to the profession have a higher level of ICT expertise than those with more years of teaching experience.

It should also be noted that teachers' participation in ICT-related training is significantly related to their level of ICT expertise (r = 0.389), indicating that more training tends to increase their level of ICT expertise. There was, however, no established relationship between teachers' level of ICT expertise and their educational attainment (r = 0.259).

Data analysis revealed a statistically significant positive relationship between teachers' level of ICT use and their number of ICT-related training (r = 0.469) at the 0.01 level. At the 0.05 level, teachers' ICT use is significantly related to their age (r = -0.319) and number of years teaching mathematics (r = -0.393). This implies that older teachers or teachers at the top of their profession have a lower level of ICT use in the classroom.

Table 5

Relationship between the Socio-Demographic Characteristics of Mathematics Teachers and Their Level of ICT Expertise, Level of Use and Beliefs about ICT Integration

Socio-Demographic Characteristics	Level of ICT Expertise	Level of ICT Use	Beliefs about ICT Integration
Age	-0.409**	-0.319*	-0.376*
Number of Years Teaching Mathematics	-0.449**	-0.393*	-0.492**
Educational Attainment	0.259	0.295	0.046
Number of ICT-related Training	0.389*	0.469**	0.387*

At the 0.01 level of significance, teachers' beliefs about ICT integration are significantly associated with their number of years teaching mathematics (r = -0.492), age (r = -0.376), and the number of ICT-related training (r = 0.387). This means that younger teachers, both in terms of age and teaching experience, have more positive beliefs about ICT integration than older teachers. It also indicates that teachers who have participated in various ICT-related trainings have a more positive attitude toward ICT integration and how ICT may successfully enhance classroom management and the teaching process.

Correlation Analysis between the Teachers' Level of ICT Expertise, Level of ICT Use and Their Beliefs about ICT Integration and Students' Problem-solving Skills

At the 0.01 level, there is a significant relationship between teachers' level of ICT expertise and level of ICT use (r = 0.796); between teachers' level of ICT expertise and beliefs about

ICT integration (r = 0.514); and between teachers' level of ICT use and their beliefs about ICT integration (r = 0.509).

Table 6

Relationship between the students' problem-solving skills and teachers' level of ICT expertise, level of ICT use and their beliefs about ICT integration.

		Student's Problem Solving Skills	Probability
I.	Level of ICT Expertise	0.552**	0.000
II.	Level of ICT Use	0.632**	0.000
III.	Beliefs about ICT Integration	0.345*	0.029

** Significant at 0.01 probability level (2-tailed)
*Significant at 0.05 probability level (2-tailed)

Students' problem solving skills is significantly correlated with each of the following teacher characteristics: level of ICT expertise (r =0.552), level of ICT use (r = 0.632) and beliefs about ICT integration (r = 0.345). The results are consistent with the findings of Leite (2019), who discovered that teachers believe that the use of technology enhances students' problem-solving abilities. Furthermore, the study's findings indicated that teachers can improve students' problem-solving skills by utilizing technology as a tool.

Conclusion

The objective of this study was to investigate the mathematics teachers' levels of ICT expertise and use, as well as their beliefs about ICT integration, and to determine possible relationships between these factors and students' problem-solving abilities. Several major conclusions can be drawn from the analysis of data and findings by employing the descriptive correlational design.

According to the study's findings, teachers' socio-demographic characteristics such as age, number of years teaching mathematics, and number of ICT-related training are indicators of teachers' levels of ICT expertise and use, as well as their beliefs about ICT integration. The younger the teachers are in age and profession, the more open they are to embracing technological innovations. Furthermore, the more training teachers attend, the better equipped they are to implement ICT in the classroom. This suggests that ongoing ICT professional development for teachers is critical in enhancing their technological skills and ensuring effective ICT integration in the mathematics classroom. This, in turn, can positively impact students' problem-solving abilities.

It is also possible to conclude that there is a significant relationship between and among teachers' levels of ICT expertise, use, and beliefs about ICT integration. Teachers with a higher level of ICT expertise integrate educational technology into their teaching more frequently. Furthermore, teachers who favor ICT as an effective tool for efficiently acquainting students with Math tend to incorporate ICT in introducing mathematical concepts to students, thereby improving their problem-solving abilities. As a result, encouraging positive attitudes toward ICT integration among teachers can lead to increased adoption and effective application of

technology in the classroom, ultimately enhancing students' problem-solving abilities and overall learning experiences.

Moreover, teachers' level of ICT expertise, level of ICT use and their beliefs about ICT integration is significantly related to the students' problem-solving skills. When teachers are equipped with ICT skills and frequently use ICT in their teaching, students' problem-solving abilities improve. Furthermore, when teachers consider the positive impact of ICT on improving the quality of mathematics instruction, students' problem-solving skills enhance. This suggests that effective integration of ICT tools and resources can create an engaging and interactive learning environment that encourages students' critical thinking and problem-solving abilities. Furthermore, when teachers recognize the positive impact of ICT on the quality of mathematics instruction, students' problem-solving skills escalate.

Based on the findings and conclusion, the following recommendations are suggested. Teachers must keep up with technological advancements in teaching, particularly in terms of aligning technologies with content and pedagogy and developing the ability to use ICT creatively to meet the specific learning needs of their students. They will be able to align instruction with standards, particularly those that embody 21st century knowledge and skills such as critical thinking and problem solving.

Teachers should be encouraged to use ICT not only in the classroom to teach mathematical concepts, but also in the development of technology-enhanced assessments that assess student mastery of higher order thinking skills. As a result, educational interventions such as ICT-related teacher training should be implemented to persuade teachers of the benefits of ICT in teaching and learning. To encourage teachers to use ICT regularly, the Department of Education and local government education authorities must provide computers, Internet access, and other ICT infrastructure in all government schools.

School administrators must provide strong support for their teachers' personal and professional development in terms of ICT literacy and educational technology-related teaching pedagogy. They must provide technical assistance, such as conducting ICT-related training during the induction seminar and workshops that may assist their teachers in continuing to integrate ICT into their classroom practice.

Teacher Training Institutions must provide knowledge, experiences, and supervision to pre-service mathematics teachers to prepare them to design and implement ICT in the classroom. These institutions' teacher preparation goals should center on student mastery of academic content and knowledge, as well as mastery of 21st-century skills such as critical thinking, problem-solving, communication, technology literacy, collaboration, and creativity.

Policymakers and developers have to develop curricula and programs that highlight various ways teachers can seize opportunities for integrating ICT tools and innovative teaching strategies into their classroom instruction. The curriculum should emphasize opportunities for students to apply technology skills across content areas while adopting a problem-solving approach to learning.

By implementing these recommendations, educators, policymakers, and institutions can promote the effective integration of ICT in mathematics education, enhancing students' problem-solving skills and preparing them for 21st-century challenges. Future researchers can build on these findings by investigating additional factors influencing teachers' ICT integration

and the long-term impact of ICT use on students' academic performance and overall development.

Furthermore, this study primarily examined the relationships between mathematics teachers' ICT factors and students' problem-solving skills. Other variables and factors that may influence students' problem-solving abilities, such as teaching methods, curriculum design, or student characteristics, were not thoroughly investigated, despite their importance. Future researchers could build on this research by conducting a more in-depth examination of the numerous factors that influence students' problem-solving abilities in mathematics, including the role of ICT integration.

Acknowledgements

The researchers wish to express their utmost gratitude to the Department of Science and Technology – Science Education Institute (DOST-SEI) of the Philippines, through the National Consortium in Graduate Science and Mathematics Education (NCGSME) for funding the conduct of this study.

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