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Technological pedagogical and content knowledge of secondary mathematics teachers in Eastern Samar division

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ABSTRACT

Today's instructional strategies are influenced by teachers' technological pedagogical content knowledge (TPACK). While several TPACK studies have been conducted in urban and mixed-subject contexts, limited research has focused specifically on secondary mathematics teachers in geographically distinct divisions such as Eastern Samar, Philippines. Addressing this gap, this study examined the TPACK of 89 secondary mathematics teachers in the Southern part of Eastern Samar division, Philippines. Using descriptive-comparative research design, data was collected through an adopted survey questionnaire and analyzed using frequency, percentage, mean, and standard deviation for the descriptive part. Independent samples t-test and analysis of variance (ANOVA) were employed at a 5% significance level to determine group differences. Results revealed that respondents demonstrated proficient TPACK overall. No significant differences were found when grouped by sex, age, specialization, teaching position, and length of teaching experience. However, significant differences emerged based on educational attainment and number of TPACK-related trainings attended. These results highlight the critical function of continuous professional learning in strengthening teachers' TPACK within the Eastern Samar context. Findings suggest sustained, structured support from Department of Education Eastern Samar division to strengthen mathematics teachers' TPACK through professional development programs.

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1. INTRODUCTION

In the Philippines, performing and competent teachers are highly recognized for the advancement of the education system [1]. The effectiveness of teachers directly influences student performance [2]. In mathematics education, learning has traditionally centered on teachers as a source of knowledge [3]. Thus, students' learning journeys depend on teachers' effectiveness, competencies, and skills. However, challenges are a natural part of mathematics. Previous studies have reported that mathematics teachers lack the necessary content knowledge and effective teaching strategies to help students learn [4]. Similarly, difficulties in pedagogical knowledge have been reported among teachers, particularly in teaching science and mathematics effectively [5], [6]. Also, inadequate professional training, limited instructional resources, and insufficient problem-solving strategies are among the common challenges experienced by mathematics teachers [7]. These instructional challenges are reflected in students' academic performance at the national and international levels.

Globally benchmarked assessments uncover the degree of the problem. In the 2022 Programme for International Student Assessment (PISA), the Philippines ranked 6th from the lowest in mathematics among 81 participating nations, with 84% of Filipino students who took the test needed more mathematical skills [8]. Similarly, results from the 2019 Trends in International Mathematics and Science Study (TIMSS) showed that only 19% of Filipino grade learners met the minimum benchmark level required in mathematics [9]. The Southeast Asia Primary Learning Metrics (SEA-PLM) further reported low ranking for Filipino students in mathematics and reading [10].

Given these persistent challenges, examining teachers' technological pedagogical content knowledge (TPACK) provides insights into how professional development can address low mathematics performance [11], [12]. One critical framework that addresses the demands of present teaching is TPACK. Effective teaching in today's digital era requires not only mastery of content and pedagogy but also the integration of technology [13]. The TPACK framework integrates content, pedagogy, and technology into technology-enhanced instruction [14], [15]. Through strong TPACK competencies, teachers can enhance learning experiences, select appropriate pedagogical strategies, and adapt instruction to meet the demands of 21st century learners [16], [17]. With sufficient knowledge of each TPACK component, teachers become competent, flexible, dynamic, and adaptive in producing effective teaching with technology [18].

Empirical evidence supports this linkage. Prior research has found a significant relationship between teachers' TPACK competencies and their teaching performance in mathematics, indicating that higher TPACK levels can improve instructional performance [19]. As technology integration reshapes the education process [20] and prepares students to fit in with the globalized digital age [21], developing teachers' TPACK become a strategic pathway for addressing low mathematics performance. However, while studies on TPACK have been conducted in various contexts, few studies have examined TPACK among secondary mathematics teachers in rural Philippine divisions. In particular, limited empirical research has focused on Eastern Samar, where professional development opportunities, technological resources, and institutional support may differ from urban centers. Understanding teachers' TPACK in this localized context is crucial, as contextual realities may influence both technology integration and instructional effectiveness.

Given these gaps, examining the TPACK of the secondary mathematics teachers in the Southern part of Eastern Samar division provides context-specific insights into how professional development initiatives can be tailored to address persistent mathematics performance issues. By focusing specifically on mathematics teachers and employing a comparative analysis across demographic and professional variables, this study contributes localized evidence to the broader TPACK literature and informs strategic interventions of the Department of Education (DepEd). Therefore, the study determined the level of TPACK of secondary mathematics teachers in the Southern part of Eastern Samar division. Specifically, it answered the questions: i) what is the demographic profile of the respondents in terms of sex, age, educational attainment, specialization, teaching position, length of teaching experience, and number of trainings attended related to TPACK in the past three years? ii) what is the level of knowledge of the respondents on the following TPACK domains: technological knowledge (TK), pedagogical knowledge (PK), content knowledge (CK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), pedagogical content knowledge (PCK), and TPACK? and iii) is there a significant difference in the respondents' level of TPACK when grouped according to their demographic profile?

2. METHOD

The researchers considered descriptive - comparative as research design of the study. The study was descriptive because it profiled the respondents according to selected demographic variables and determined their level of TPACK knowledge. Also, the study was comparative because it compared the respondents' level of TPACK knowledge when they are grouped according to their demographic profile. A total of 89 secondary mathematics teachers from the Southern part of Eastern Samar division participated in the study. Stratified random sampling was used to ensure fair and proportional representation of math teachers from different secondary schools within the research locale. School served as strata, and the number of teacher-respondents selected from each school was proportionate to their actual population of secondary mathematics teachers. This approach was chosen to minimize sampling bias, improve representativeness across geographically distributed schools, and ensure that both large and small schools contributed appropriately to the sample. The final sample size met the minimum sample size required for comparative analysis and was considered sufficient to support robust comparative analysis in TPACK dimensions across selected teacher characteristics.

In gathering the data needed, the research instrument was adapted from an established TPACK survey and administered in English, the primary language of instruction among secondary mathematics teachers in the division [22]. Prior to full administration, the instrument underwent content validation by experts in mathematics education and educational technology. A pilot test was conducted among secondary mathematics teachers who were not part of the final sample. Reliability analysis yielded acceptable Cronbach's alpha values across all TPACK dimensions ranging from 0.80-0.92, indicating satisfactory internal consistency. These values suggest that the items within each domain consistently measured the same underlying construct, thereby strengthening the credibility and reliability of the instrument.

The final instrument consists of 42 items distributed across 7 domains: TK (7 items), PK (7 items), CK (6 items), TPK (5 items), TCK (6 items), PCK (6 items), and TPACK (5 items). All items were organized in a 5-point Likert rating scale, where 5=strongly agree, 4=agree, 3=neither agree/disagree, 2=disagree, and 1=strongly disagree.

Ethical considerations were strictly observed throughout the study. Permission to conduct the research was obtained from the schools division superintendent of Eastern Samar division. Participation of teachers was voluntary, and informed consent was secured prior to data collection. Respondents were assured that their responses would be treated with confidentiality and used solely for research purposes. No identifying information was disclosed in the analysis and reporting of results to protect participants' anonymity.

For data analysis, frequency, percentage, mean scores, and standard deviation were used to answer questions on demographic profile and level of TPACK knowledge. On the other hand, independent samples t-test and ANOVA were used to compare respondents' level of TPACK knowledge considering their demographic profile. The level of significance was set at 5% for statistical tests.

3. RESULTS AND DISCUSSION

3.1. Demographic profile of the respondents

The study examined the demographic profile of the secondary mathematics teachers in the Southern part of Eastern Samar division. It can be noted from Table 1 that most respondents were female (60.70%), aged 45-64 years old (34.80%), largely mathematics majors (80.90%), and predominantly in teacher I-III positions (86.50%) with 6-10 years of teaching experience (28.10%). A substantial proportion had units in masters (66.30%), and nearly half (44.90%) had attended 7 or more TPACK-related training/seminars in the past three years.

Table 1. The demographic profile of the respondents

Variable	Categories	Frequency	Percentage
Sex	Male	35	39.30
	Female	54	60.70
	Total	89	100.00
Age	22-34 years old	29	32.60
	35-44 years old	29	32.60
	45-64 years old	31	34.80
	Total	89	100.00
Educational attainment	BS graduate	13	14.60
	With units in masters	59	66.30
	Masters' degree holder	15	16.90
	With units in doctorate	2	2.20
	Total	89	100.00
Specialization	Mathematics major	72	80.90
	Non-mathematics major	17	19.10
	Total	89	100.00
Teaching position	Teacher I-III	77	86.50
	Master teacher	12	13.50
	Total	89	100.00
Length of teaching experience	5 years and below	24	27.00
	6-10 years	25	28.10
	11-15 years	10	11.20
	16-20 years	12	13.50
	21 years and above	18	20.20
	Total	89	100.00
Number of trainings attended related to TPACK for the past three years	2 trainings and below	7	7.90
	3-4 trainings	32	36.00
	5 -6 trainings	10	11.20
	7 trainings and above	40	44.90
	Total	89	100.00

Results of the analysis indicate that Southern part of Eastern Samar division is dominated by female mathematics teachers, reflecting the broader trend of teaching as a female-dominated profession. The presence of late-career teachers in the division suggests institutional steadiness and accumulated classroom expertise. However, it also implies that a significant fraction of teachers was trained in a period when digital technologies were not yet central to instruction. At the same time, the presence of early- to mid-career teachers indicates a parallel openness to innovation, as educators in this stage are more receptive to adopting new technologies. Respondents consider professional advancement as an integral part of their profession through education and training/seminars. Mathematics education in the division is largely grounded in the experiences of teachers formally trained in mathematics.

3.2. Level of TPACK of the respondents

The study also investigated the TPACK of the respondents. Tables 2-8 presents TK, PK, CK, TPK, TCK, PCK, and TPACK based on the results of the analysis.

3.2.1. Technological knowledge

It can be noted from Table 2 that respondents are proficient with their TK with a mean score of 3.76, implying that teachers are knowledgeable enough about various technologies, ranging from low to high-tech tools that are used for mathematics instruction to optimize students' learning. Such proficiency enables respondents to support the abstract and content-heavy nature of the mathematics curriculum, where visualization tools and digital resources support conceptual understanding. Teachers possess a competent level of digital skills, suggesting their readiness to engage in basic digital instruction [23]. In addition, this result of the study can be explained by the DepEd's computerization program, which was found to be highly effective, where teachers highly satisfactorily improve their computer literacy and use of technology [24].

Table 2. The level of TK of the respondents

No.	Statement	Mean	Standard devistion	Interpretation
1.	I know how to solve my own technical problems	4.06	0.83	Agree
2.	I can learn technology easily	4.08	0.81	Agree
3.	I keep up with important new technologies	3.97	0.85	Agree
4.	I frequently play around with the technology	3.73	0.89	Agree
5.	I know about a lot of different technologies	3.46	0.78	Agree
6.	I have the technical skills I need to use technology	3.57	0.85	Agree
7.	I have had sufficient opportunities to work with different technologies	3.46	0.82	Agree
	Weighted mean	3.76	0.65	Proficient

3.2.2. Pedagogical knowledge

The domain got a computed mean score of 4.20, indicating a proficient level of knowledge among the respondents, as shown in Table 3. This result suggests that respondents are well-versed in the development of the teaching-learning process in secondary mathematics, where instruction normally includes structured lesson sequences, guided practice, problem-solving activities, and formative assessment [25]. Given the spiral and cumulative nature of the mathematics curriculum, a proficient level of PK allows teachers to create a conducive mathematics learning environment where students actively engage in learning, varied learning styles and abilities of the students are recognized, and students' mathematical knowledge is evaluated effectively [26]. As a result, there are better student outcome [27]. Moreover, the result of the study can be explained by the number of respondents who received formal academic training in math, including training courses related to pedagogy, and their exposure to different professional education courses.

Table 3. The level of PK of the respondents

No.	Statement	Mean	Standard devistion	Interpretation
1.	I know how to assess student performance in a classroom	4.40	0.83	Strongly agree
2.	I can adapt my teaching based upon what students currently understand and do not understand	4.33	0.92	Strongly agree
3.	I can adapt my teaching style to different learners	4.18	0.79	Agree
4.	I can assess student learning in multiple ways	4.08	0.88	Agree
5.	I can use a wide range of teaching approaches in a classroom setting	4.10	0.87	Agree
6.	I am familiar with common student understandings and misconceptions	4.01	0.92	Agree
7.	I know how to organize and maintain classroom management	4.29	0.88	Strongly agree
	Weighted mean	4.20	0.76	Proficient

3.2.3. Content knowledge

The results of the study revealed that the respondents were not updated on current research findings in mathematics, which are an important source of new knowledge in the field. However, looking at the general result, CK of secondary mathematics teachers was still found to be proficient, supported by a mean score of 3.96 as shown in Table 4, indicating a comprehensive knowledge and understanding in theories, concepts, and practices required in the mathematics curriculum. Given the innate content complexity of mathematics, high CK is essential for accurate explanation, problem modeling, and lesson sequencing. Mathematics teachers need a strong understanding of the subject matter they teach, as the nature of mathematics inherently requires various forms of knowledge. Mathematics teachers are responsible for teaching students, which entails outlining their teaching materials and planning daily lessons effectively [4], [28].

Table 4. The level of CK of the respondents

No.	Statement	Mean	Standard devistion	Interpretation
1.	I have sufficient knowledge about mathematics	4.09	0.89	Agree
2.	I can use a mathematical way of thinking	4.16	0.98	Agree
3.	I have various ways and strategies of developing my understanding of mathematics	4.12	0.94	Agree
4.	I am familiar with recent research in mathematics	3.39	0.91	Neither agree/disagree
5.	I know the basic theories and concepts of mathematics	4.17	0.89	Agree
6.	I know how history and development of important theories in mathematics	3.82	0.84	Agree
	Weighted mean	3.96	0.79	Proficient

3.2.4. Technological pedagogical knowledge

The respondents rated their TPK with a mean score of 3.99, interpreted as proficient and with all indicators rated as agree from 3.96-4.02, as shown in Table 5. This indicates that respondents are capable of aligning technological tools with pedagogical strategies frequently used in secondary mathematics classrooms, such as problem-based learning, collaborative tasks, and guided discovery. This finding also suggests that teachers understand how technology can modify or enhance pedagogical approaches in mathematics to improve or change both teaching and learning process/experience [29]. Teachers' knowledge on effectively implementing technology in classroom settings plays an important role in exploiting the potential of technology to support students' learning processes [30]. Further, teachers perceive that their basic training allows them to value and reflect on how technology affects their teaching approaches and how to integrate it in the classroom [31].

Table 5. The level of TPK of the respondents

No.	Statement	Mean	Standard devistion	Interpretation
1.	I can choose technologies that enhance the teaching approaches for a lesson	3.96	0.94	Agree
2.	I can choose technologies that enhance students' learning for a lesson	3.96	0.98	Agree
3.	My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom	4.02	0.88	Agree
4.	I am thinking critically about how to use technology in my classroom	4.02	0.84	Agree
5.	I can adapt the use of the technologies that I am learning about to different teaching activities	4.00	0.91	Agree
	Weighted mean	3.99	0.72	Proficient

3.2.5. Technological content knowledge

In terms of TCK, the secondary mathematics teachers rated this domain with a mean score of 3.68, interpreted as proficient. Also, all indicators were rated agree by the respondents with mean score ranging from 3.53-3.97, as shown in Table 6. This result suggests that respondents understand how specific technologies can be used to represent and explore mathematical content more effectively. Digital tools available at hand can enhance or transform content and how the content can be delivered to students [32]. In mathematics, technology offers powerful means of visualization and manipulation of abstract concepts. Digital tools such as graphing software and dynamic geometry applications, allow teachers to present content in ways that align with curriculum standards and learners' cognitive needs.

3.2.6. Pedagogical content knowledge

It can be gleaned from the Table 7 that secondary mathematics teachers are proficient in this domain given the mean score of 4.16. Moreover, respondents were found to have advanced level on evaluating student's performance in mathematics, explaining essential content of mathematics, and giving appropriate feedback to areas where learners find it difficult to understand. This finding highlights the respondents' expertise in choosing appropriate representations, explanations, and examples suited to secondary learners' developmental levels. Likewise, this study describes the high level of respondent's understanding of the best teaching practices or pedagogies used to convey mathematics content to the learners [33]. Thus, teachers have effective ways of representing content and are formulated to make it comprehensible to students.

Table 6. The level of TCK of the respondents

No.	Statement	Mean	Standard devistion	Interpretation
1.	I know how technological developments have changed the field of mathematics	3.97	0.96	Agree
2.	I can explain which technologies have been used in research in mathematics	3.54	0.95	Agree
3.	I know which technologies are currently being developed in the field of mathematics	3.54	0.90	Agree
4.	I know how to use technologies to participate in scientific discourse in mathematics	3.53	0.68	Agree
5.	I know technologies which help me understand mathematics	3.70	0.90	Agree
6.	I know how to use essential technologies which are specific to mathematics	3.80	0.83	Agree
	Weighted mean	3.68	0.71	Proficient

Table 7. The level of PCK of the respondents

No.	Statement	Mean	Standard devistion	Interpretation
1.	I know how to select effective teaching approaches to guide student thinking and learning in mathematics	4.01	0.79	Agree
2.	I know how to develop appropriate tasks to promote students' complex thinking in mathematics	3.97	0.82	Agree
3.	I know how to develop exercises with which students can consolidate their knowledge in mathematics	4.11	0.92	Agree
4.	I know how to evaluate students' performance in mathematics	4.28	0.88	Strongly agree
5.	I can explain essential content in mathematics in ways that students can understand	4.30	0.78	Strongly agree
6.	In my mathematics class, I can identify from student errors where there are difficulties in understanding and giving appropriate feedback	4.27	0.83	Strongly agree
	Weighted mean	4.16	0.67	Proficient

3.2.7. Technological pedagogical content knowledge

Lastly, on the construct of TPACK, respondents rated themselves as proficient with a computed mean score of 3.98 and with all indicators rated as agree ranging from 3.83-4.09, as shown in Table 8. Result of the study suggests that respondents possess an integrated understanding of how technology, pedagogy, and content interact within actual mathematics classroom contexts. Specifically, teachers can select technologies that align with both the instructional strategies they employ and the mathematical concepts being taught, thereby enhancing students' learning experiences. In a curriculum characterized by abstract reasoning, procedural rigor, and problem-solving demands, such integration is essential for effective instruction. With adequate knowledge of the TPACK component, teachers become more competent in bringing effective technology-integrated instruction that responds to curricular requirements and learner needs [18].

Table 8. The level of TPACK of the respondents

No.	Statement	Mean	Standard devistion	Interpretation
1.	I can teach lessons that appropriately combine mathematics, technologies, and teaching approaches	4.09	0.91	Agree
2.	I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn	3.97	0.83	Agree
3.	I can use strategies that combine content, technologies, and teaching approaches that I learned about my coursework in my classroom	3.99	0.87	Agree
4.	I can provide leadership in helping others to coordinate the use of content, technologies, and teaching approaches at my school and/or district	3.83	0.85	Agree
5.	I can choose technologies that enhance the content for a lesson	4.04	0.82	Agree
	Weighted mean	3.98	0.79	Proficient
	Overall weighted mean	3.96	0.62	Proficient

3.2.8. Difference on respondents' level of TPACK

Table 9 presents the comparative analysis of TPACK across demographic characteristics of the respondents. Results reveal no significant differences in TPACK when grouped according to sex ($p=0.416$), age (p=0.267), specialization (p=0.792), teaching position (p=0.171), and length of teaching experience (p=0.413). This result implies that respondents do not vary considerably from one another considering the demographic profiles.

Table 9. Difference between respondents' level of TPACK when grouped according to technological profile

Dependent variable	Independent variable (demographic profile)	Categories	Mean	t-value/f-value	p-value (α=0.05)	Interpretation
Level of TPACK	Sex	Male	3.98	0.818	0.416	Not significant
		Female	3.94			
	Age	22-34 years old	4.06	1.342	0.267	Not significant
		35-44 years old	4.00			
		45-64 years old	3.83			
	Educational attainment	BS graduate	3.90	3.589	0.018	Significant
		With units in masters	3.93			
		Masters' degree holder	3.96			
		With units in doctorate	4.05			
	Specialization	Math major	3.99	0.265	0.792	Not significant
		Non-math major	3.93			
	Teaching position	Teacher I-III	3.89	0.360	0.171	Not significant
		Master teacher	4.02			
	Length of teaching experience	5 years and below	4.12	0.999	0.413	Not significant
		6-10 years	4.10			
		11-15 years	4.00			
		16-20 years	3.87			
		21 years and above	3.72			
	No. of trainings attended related to TPACK for the past three years	2 trainings and below	3.70	2.936	0.038	Significant
		3-4 trainings	3.98			
		5-6 trainings	4.01			
		7 trainings and above	4.14			

The absence of significant differences by sex aligns with prior studies [34], suggesting that gender does not substantially influence TPACK acquisition. Similarly, the non-significant variation across teaching positions supports findings that rank alone does not determine technology integration competence [35]. Although some literature reports that younger teachers tend to exhibit stronger TPACK due to greater technological familiarity [36], [37], this pattern was not observed in the present study. This may indicate that professional development initiatives in Eastern Samar have helped bridge potential generational gaps in technology use. Likewise, the lack of significant differences based on specialization challenges assumptions that stronger content knowledge and greater familiarity with mathematics pedagogy positively influence TPACK [38]. Lastly, the present study failed to support the idea that experience automatically translates to stronger TPACK [39]. The finding supports arguments that exposure to targeted training may matter more than longevity in service.

More notably, significant differences emerged in educational attainment (p=0.018) and number of TPACK-related trainings attended (p=0.038). Teachers with higher educational qualifications revealed higher TPACK levels, suggesting that advanced academic engagement improves integrated technological, pedagogical, and content competencies. Graduate studies often expose teachers to research-based instructional strategies and technology-enhanced methodologies, which may explain this difference [40]. Even more fascinating is the significant impact of training exposure. Teachers who attended seven or more training courses reported the highest TPACK levels (mean=4.14), while those with two or fewer training courses had the lowest (mean=3.70). This implies that structured, sustained professional development has a stronger influence on TPACK than years of teaching experience. Unlike experience which may reinforce established routines, targeted training launches updated tools, reflective practice, and innovative integration strategies. This finding reinforces literature emphasizing that intentional academic advancement and sustained professional development directly cultivates teachers' ability to integrate technology effectively [31].

4. CONCLUSION

This study examined the TPACK of secondary mathematics teachers in the Southern part of the Eastern Samar division, Philippines. Findings revealed that teachers demonstrated an overall proficient level of TPACK, indicating that they possess a solid understanding of how content, pedagogy, and technology interact in mathematics instruction. Respondents' TPACK is cultivated through intentional academic advancement and sustained professional development. With this, the researchers recommend sustained, structured support from DepEd Eastern Samar division to strengthen mathematics teachers' TPACK through advanced education and professional development programs focused on mathematics technology integration such as workshops, peer mentoring and professional learning communities. These initiatives can be embedded within DepEd's results-based performance management system (RPMS) and Philippine Professional Standards for Teachers (PPST) frameworks to ensure that TPACK training supports sustained technology integration and becomes a core component of ongoing teacher development.

In addition, the recommendation to conduct a teaching demonstration festival highlighting best practices in mathematics instruction may serve as a division-wide platform for recognizing innovative teachers, disseminating effective TPACK-based strategies. Such an initiative can foster a culture of collaboration, professional recognition, and shared learning. This study has limitations. The results are based on self-reported data, which may be influenced by the subjectivity of respondents and could introduce response bias. Additionally, TPACK was assessed at a single point of time. Hence, future studies could address this limitation through qualitative follow-ups such as classroom observations and peer evaluations to see how TPACK manifests in practice.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors state no conflicts of interest regarding the publishing of this work. They certify that there were no financial, political, personal, religious, ideological, academic, or intellectual competing interests.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

DATA AVAILABILITY

The data that supports the findings of this study are available on request from the corresponding author, [RDG]. The data, which contains information that could compromise the privacy of research respondents, is not publicly available due to certain restrictions.

REFERENCES

[1] M. T. Cabradilla, "Teachers' competency based on the Philippine professional standards for teachers I-III: basis for a training program," *International Journal of Multidisciplinary Research and Analysis*, vol. 08, no. 04, 2025, doi: 10.47191/ijmra/v8-i04-64.

[2] F. Fadlun and E. Fatmawati, "The effect of teacher performance on academic achievement of elementary school," *An-Nidzam : Jurnal Manajemen Pendidikan dan Studi Islam*, vol. 10, no. 1, pp. 39–49, 2023, doi: 10.33507/an-nidzam.v10i1.1128.

[3] K. A. Alshehri and N. H. Youssef, "The influence of mathematical knowledge for teaching towards elementary teachers' mathematical self-efficacy," *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 18, no. 6, 2022, doi: 10.29333/ejmste/12086.

[4] R. H. Mohamed, I. A. Khalil, and B. M. Awaji, "Mathematics teachers' awareness of effective teaching practices: a comparative study," *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 19, no. 2, 2023, doi: 10.29333/ejmste/12962.

[5] A. S. Belayneh, "Science teachers' integrative practices in teaching, research, and community services: the case of three universities in Ethiopia," *Education and Self Development*, vol. 16, no. 2, pp. 10–26, 2021, doi: 10.26907/esd.16.2.02.

[6] M. Usak, A. R. Masalimova, E. I. Cherdymova, and A. R. Shaidullina, "New playmaker in science education: COVID-19," *Journal of Baltic Science Education*, vol. 19, no. 2, pp. 180–185, 2020, doi: 10.33225/jbse/20.19.180.

[7] N. Ntereke and M. Mphunyane "Perceptions of secondary school mathematics teachers and the challenges faced in implementing grade 9 curriculum: a case of two schools in Lesotho," *Journal of Mathematics and Science Teacher*, vol. 5 no. 2, pp. 1–11, 2025, doi: 10.29333/mathsciteacher/16060.

[8] J. V. Acido and D. G. Caballes, "Assessing educational progress: a comparative analysis of PISA results (2018 vs. 2022) and HDI correlation in the Philippines," *World Journal of Advanced Research and Reviews*, vol. 21, no. 1, pp. 462–474, 2024, doi: 10.30574/wjarr.2024.21.1.0020.

[9] J. Magas, "Predictors of students' performance in TIMSS mathematics released items," *Psychology and Education: A Multidisciplinary Journal*, vol. 6, no. 11, pp. 1–1, 2023.

[10] L. B. Ignacio, A. G. A. Cristobal, and P. C. David, "Impact of policy implementation on education quality: a case study on Philippines' low ranking in international and local assessment programs," *Asian Journal on Perspectives in Education*, vol. 3, no. 1, pp. 41–54, 2022, doi: 10.63529/ajpe.v3i1.7663.

[11] N. A. Oredina and R. D. Ebueza, "Teachers' competence and students' academic performance in mathematics: a brief cross-sectional case in Don Mariano Marcos Memorial State University, Philippines," *Universal Journal of Educational Research*, vol. 8, no. 12A, pp. 7766–7774, 2020, doi: 10.13189/ujer.2020.082564.

[12] H. Aguhayon, R. Tingson, and J. Pentang, "Addressing students learning gaps in mathematics through differentiated instruction," *International Journal of Educational Management and Development Studies*, vol. 4, no. 1, pp. 69–87, 2023, doi: 10.53378/352967.

[13] M. A. T. Jacinto and F. A. Samonte, "Anxiety and efficacy in computer technology integration among secondary school teachers of Angadanan, Isabela, Philippines," *Journal of BIMP-EAGA Regional Development*, vol. 7, no. 1, pp. 57–65, 2022, doi: 10.51200/jbimpeagard.v7i1.3695.

[14] J. C. A. Akun and F. S. Mohamad, "Technological pedagogical content knowledge (TPACK) and the teaching of science: determiners for professional development," *Estudios de Economia Aplicada*, vol. 39, no. 1, 2021, doi: 10.25115/eea.v39i1.4272.

[15] S. Li, Y. Liu, and Y. S. Su, "Differential analysis of teachers' technological pedagogical content knowledge (TPACK) abilities according to Teaching Stages and Educational Levels," *Sustainability (Switzerland)*, vol. 14, no. 12, 2022, doi: 10.3390/su14127176.

[16] J. C. Plantado, "Usage of classroom technology and the technological pedagogical content knowledge (TPACK) of mathematics teachers," *Southeast Asian Mathematics Education Journal*, vol. 13, no. 1, pp. 43–56, 2023, doi: 10.46517/seamej.v13i1.175.

[17] E. Mohammadpour and Y. Maroofi, "A performance-based test to measure teachers' mathematics and science content and pedagogical knowledge," *Heliyon*, vol. 9, no. 3, 2023, doi: 10.1016/j.heliyon.2023.e13932.

[18] A. B. Aquino, A. A. Dadayan, M. E. Rosel, and M. J. V. Francisco, "Development of a TPACK-based professional development framework for the new normal in education," *International Journal of Information and Education Technology*, vol. 12, no. 10, pp. 1012–1016, 2022, doi: 10.18178/ijiet.2022.12.10.1713.

[19] N. B. M. Monterde, "TPACK Correlates mathematics teachers' performance in selected Private Higher Education Institutions (PHEIS)," *GEO Academic Journal*, vol. 4, no. 1, 2023, doi: 10.56738/issn29603986.geo2023.4.41.

[20] Ş. B. Tosuntaş, Z. Çubukçu, and G. Beauchamp, "A new model for the factors that affect interactive whiteboard usage of teachers and its effect on performance," *Education and Information Technologies*, vol. 26, no. 3, pp. 3575–3592, 2021, doi: 10.1007/s10639-021-10428-z.

[21] E. B. Demissie, T. O. Labiso, and M. W. Thuo, "Teachers' digital competencies and technology integration in education: insights from secondary schools in Wolaita Zone, Ethiopia," *Social Sciences and Humanities Open*, vol. 6, no. 1, 2022, doi: 10.1016/j.ssaho.2022.100355.

[22] D. A. Schmidt, E. Baran, A. D. Thompson, P. Mishra, M. J. Koehler, and T. S. Shin, "Technological pedagogical content knowledge (TPACK): the development and validation of an assessment instrument for preservice teachers," *Journal of Research on Technology in Education*, vol. 42, no. 2, pp. 123–149, Dec. 2009, doi: 10.1080/15391523.2009.10782544.

[23] K. K. Baybay and I. Lantaka, "Teachers' digital competence, readiness and challenges in the 21st century education," *International Journal of Research in Interdisciplinary Studies*, vol. 3, no. 6, pp. 277–286, 2025.

[24] R. S. Mula and J. D. Bucar, "Department of education computerization program (DCP): its effectiveness and problems encountered in school personnel's computer literacy," *International Journal of Multidisciplinary: Applied Business and Education Research*, vol. 4, no. 4, pp. 1221–1250, 2023, doi: 10.11594/ijmaber.04.04.19.

[25] A. M. Ortiz Colón, T. Izquierdo Rus, J. Rodríguez Moreno, and M. Agreda Montoro, "TPACK model as a framework for in-service teacher training," *Contemporary Educational Technology*, vol. 15, no. 3, 2023, doi: 10.30935/cedtech/13279.

[26] M. I. Pascual, M. Montes, and L. C. Contreras, "The pedagogical knowledge deployed by a primary mathematics teacher educator in teaching symmetry," *Mathematics*, vol. 9, no. 11, 2021, doi: 10.3390/math9111241.

[27] H. Ulferts, "Teaching as a knowledge profession: studying pedagogical knowledge across education systems," *Educational Research and Innovation*, p. 165, 2021.

[28] M. F. Y. Annazar, R. Firdaus, and D. Andra, "Technology pedagogical content knowledge (TPACK): an analysis of ability of elementary school teacher," in *Proceedings of the 4th International Conference on Progressive Education 2022 (ICOPE 2022)*, 2023, pp. 669–684, doi: 10.2991/978-2-38476-060-2_61.

[29] R. Nantschev *et al.*, "Teaching approaches and educational technologies in teaching mathematics in higher education," *Education Sciences*, vol. 10, no. 12, Nov. 2020, doi: 10.3390/educsci10120354.

[30] C. Wekerle and I. Kollar, "Fostering pre-service teachers' situation-specific technological pedagogical knowledge – does learning by mapping and learning from worked examples help?" *Computers in Human Behavior*, vol. 115, 2021, doi: 10.1016/j.chb.2020.106617.
[31] S. Sofyan *et al.*, "TPACK–UotI: the validation of an assessment instrument for elementary school teachers," *Humanities and Social Sciences Communications*, vol. 10, no. 1, 2023, doi: 10.1057/s41599-023-01533-0.
[32] A. Uzorka and O. A. Odebiyi, "Impact of digital learning tools on student engagement and achievement," *Journal of Digital Learning and Distance Education*, vol. 4, no. 1, pp. 1436–1445, 2025, doi: 10.56778/jdlde.v4i1.511.
[33] J. M. Furner, "The best pedagogical practices for teaching mathematics revisited: using math manipulatives, children's literature, and GeoGebra to produce math confident young people for a STEM world," *Pedagogical Research*, vol. 9, no. 2, 2024, doi: 10.29333/pr/14194.
[34] T. Kosiol and S. Ufer, "Teachers' self-reported and actual content-related TPACK – new results on their relation and gender differences," *Computers and Education Open*, vol. 7, 2024, doi: 10.1016/j.caeo.2024.100205.
[35] W. Thinzarkyaw, "The practice of technological pedagogical content knowledge of teacher educators in education colleges in Myanmar," *Contemporary Educational Technology*, vol. 11, no. 2, pp. 159–176, 2020, doi: 10.30935/cet.660829.
[36] F. N. Kumala, A. Ghufron, and P. Pujiastuti, "Elementary school teachers' TPACK profile in science teaching based on demographic factors," *International Journal of Instruction*, vol. 15, no. 4, pp. 77–100, 2022, doi: 10.29333/iji.2022.1545a.
[37] R. V. Staddon, "Bringing technology to the mature classroom: age differences in use and attitudes," *International Journal of Educational Technology in Higher Education*, vol. 17, no. 1, 2020, doi: 10.1186/s41239-020-00184-4.
[38] A. N. B. Ling and M. S. Mahmud, "Challenges of teachers when teaching sentence-based mathematics problem-solving skills," *Frontiers in Psychology*, vol. 13, 2023, doi: 10.3389/fpsyg.2022.1074202.
[39] X. Zhou, Y. Padron, and H. Waxman, "Exploring the relationship between professional development experience and skills in educational technology integration among primary EFL teacher," *Contemporary Educational Technology*, vol. 14, no. 1, 2022, doi: 10.30935/cedtech/11365.
[40] H. Shafie, F. A. Majid, and W. N. E. H. Sharil, "Education qualifications and teaching experience on the 21st century TPACK level of English language teachers," in *Proceedings of the 4th International Conference on English Language Teaching (ICON-ELT 2023)*, 2024, pp. 4–15, doi: 10.2991/978-2-38476-120-3_2.

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