FCIC INSIGHTS
An Interdisciplinary Journal

P-ISSN: 1656-6483
E-ISSN: 1984-9977

ORIGINAL ARTICLE OPEN ACCESS Volume 03 | Issue 02 | Article 01 | 2025

TECHNOLOGICAL, PEDAGOGICAL, AND CONTENT KNOWLEDGE (TPACK) OF SELECTED PRIVATE SCHOOL PRE-SERVICE TEACHERS IN THE 5TH DISTRICT OF LEYTE

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ABSTRACT

This study aimed to assess the Technological Pedagogical and Content Knowledge (TPACK) of selected pre-service teachers from private schools in the 5th District of Leyte. Utilizing a quantitative, descriptive-correlational research design, the study involved 254 pre-service teachers as respondents. The demographic profile revealed that 73% of the respondents were female, while 27% were male. English majors made up the largest group (35%) due to the common offering of this major in the selected private institutions. Statistical mean analysis indicated that pre-service teachers demonstrated sufficient knowledge across various TPACK indicators: they showed competence in several indicators under Content Knowledge (CK), and broader understanding in most indicators under Pedagogical Knowledge (PK) and Technological Knowledge (TK). Chi-square tests revealed a statistically significant difference in pre-service teachers' knowledge across the three TPACK domains: Content, Pedagogy, and Technology. However, no significant relationship was found between the socio-demographic profile of the respondents and their levels of knowledge in CK, PK, and TK. The respondents' major showed no significant relationship with their knowledge in Pedagogy and Technology, but a significant relationship was found with their Content Knowledge. Based on these findings, a training program was proposed to further enhance the TPACK competencies of pre-service teachers.

Keywords: ***TPACK, Pre-Service Teachers, Content Knowledge, Pedagogical Knowledge, Technological Knowledge, Pre-service Teacher's TPACK, Pre-service Teacher's Extent knowledge of TPACK, Measuring Pre-service Teacher's TPACK***

Received: August 2025
Accepted: October 2025
Available: December 2025

Recommended Citation:

Vilbar, D.E.L., & Gonzaga, M.V. (2025). Technological Pedagogical and Content Knowledge (TPACK) of Selected Private School Pre-Service Teachers in the 5th District of Leyte. *Franciscan College of the Immaculate Conception Insights. 3*(2) 1-16. https://doi.org/10.5281/zenodo.18204559

INTRODUCTION

A framework called Technological Pedagogical and Content Knowledge (TPACK) was created to help teachers successfully incorporate technology into their lessons. It is more than just putting technology in the classroom; it involves knowing how technology connects to the topic to teach and the pedagogical knowledge to deliver. The importance of assessing the teachers' TPACK leads to the promotion of professional development, upskill digital skills and knowledge, develop effective teaching practices, and for the teacher to use technology both within and outside of the classroom with proper integration in pedagogy and subject matter. The teacher adapts to the diverse needs of learners, increases student engagement and motivation, and prepares students for the digital world. High TPACK skill development is probable for pre-service teachers who have high self-efficacy for incorporating technology (Diamah et al. 2024).

Teachers need to be knowledgeable, efficient, and successful due to the recent changes in the Philippine basic education curriculum brought about by the K–12 Reform, ASEAN Integration, globalization, and the demands of 21st-century learners. The Department of Education Order No. 42, s. 2017 titled "Philippine Professional Standards for Teachers" (Ramos, et al., 2020) expects a beginning teacher to have a strong understanding of the subject in terms of content knowledge and pedagogy while demonstrating skills in the positive use of information and communications technology (ICT) to facilitate the teaching and learning process. Commission on Higher Education also stated in Memorandum No. 74 Policies, Standards, and Guidelines for Bachelor of Elementary Education (BEEd), s.2017 and No. 75 Policies, Standards, and Guidelines for Bachelor of Secondary Education (BSEd), s.2017 that under these programs, undergraduates develop, utilize, and apply ICT in their educational practices as one of the program outcomes.

With this, Hew et al. (2019) assert that integrating technology into a lesson's delivery is known as Technological Pedagogical Content Knowledge, or TPACK. He further asserts that the TPACK framework is a popular tool for assessing how well instructors use digital tools in the classroom, and teachers must be proficient in pedagogy, subject matter, and technology. With this, Nuangchalerm (2020) asserts that reviewing the significance of having an understanding is seen to be important to create knowledge of the opportunities and difficulties present in TPACK for teacher development and preparation programs. Furthermore, Juhji & Nuangchalerm (2020) contend that TPACK is a crucial component of students' learning accomplishment in a variety of subjects, including science, and it is inextricably linked to the learning process. Moreover, Santos & Castro (2021) state that every facet of learning, which is crucial to the process of teaching and learning, has an excellent applicability in this regard, and through the efficient use of technology to enhance content learning, pre-service teachers with TPACK training may help improve students' results. These claims are supported by Tondeur et. al. (2019), who conclude that a pre-service teacher's positive TPACK perception can lead to appropriate collaboration with peers and learning how to utilize technology. Thus, Howard et. al. (2021) posit that TPACK can enhance pre-service teacher teaching motivation.

However, Kohen & Borko (2019) demonstrate how difficult it is for teachers, especially pre-service ones, to put the theory they learn in professional development or training programs

into reality. As stated in Janssen et al. (2019), the integration of technology and pedagogy did not result in higher quality because of a lack of knowledge on the TPACK basic components. On the basis of Valtonen et al. (2020), content can be generated for strategies that help pre-service teachers overcome obstacles by recognizing their areas of concern and interpreting them in terms of TPACK. Therefore, TPACK is necessary to develop during the teacher's pre-service stage.

With the awareness of TPACK, it can deliver effective strategies in their pedagogies with technology as a tool and enhance further content knowledge. This also aids in the appreciation and utilization of available technologies that can be beneficial in learning. With the possessed knowledge, pre-service teachers will be prepared to teach with technology in the field of teaching and to possess the quality of being a 21st-century educator. Private school administrators can provide relevant training and program enhancement for pre-service teachers to make them globally competitive educators, and to keep up with the standards mandated by CHED.

While there is empirical research surrounding the TPACK of pre-service teachers, there remains a need for comprehensive studies regarding the TPACK of pre-service teachers in private schools. According to Lalbiakzuali & Mishra (2024), the TPACK of pre-service teachers requires more research in public and private institutions. Hence, this study aims to measure the Technological, Pedagogical, and Content Knowledge (TPACK) of selected Private School Pre-Service Teachers in the 5th District of Leyte. These private schools are a potential pool of applicants to private and public schools in Leyte because of the variety of specializations offered in schools. It is important to identify the knowledge areas of pre-service teachers that need to be improved so that they will be prepared for practice teaching. The results of this finding will help private schools to identify and recommend areas that need improvement. Pre-service teachers in the private school will gain an understanding of the TPACK framework and how technology is being utilized in the classroom. Future researchers on this study may use this as a source of information for their literature.

Research Questions

This study assessed the knowledge of private school pre-service teachers on Technological Pedagogical Content Knowledge (TPACK). Specifically, this study answered the following questions:

1. What is the socio-demographic profile of the pre-service teachers as to:
    1.1. Sex; and
    1.2. Major?

2. What is the extent of pre-service teachers' knowledge in terms of:
    2.1. Content Knowledge (CK);
    2.2. Pedagogical Knowledge (PK); and
    2.3. Technological Knowledge (TK)?

3. Is there a significant difference in the knowledge of pre-service teachers in terms of Content, Pedagogy, and Technology?

4. Is there a significant relationship between the socio-demographic profile of the pre-service teachers and the extent of pre-service teachers' knowledge in terms of Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK)?
5. What can be proposed based on the results of the study?

METHODOLOGY

This research utilized a Quantitative Descriptive Correlational design. It is used to determine the relationship between Content Knowledge, Pedagogical Knowledge, Technological Knowledge, and the pre-service teachers' extent of knowledge of TPACK. The descriptive component of this study is the pre-service teachers' socio-demographic profile in terms of sex, major, and their level of knowledge of TPACK. The correlational component is centered on the relationship between Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK) to the pre-service teachers' extent of knowledge of TPACK. According to Aprecia et al. (2022), the variables in a descriptive correlational study design are described, and the strength of the associations between and among the variables is measured. Villahermosa et al. (2024) emphasized that to describe the differences of groups in a population without the intervention of the independent variable, a Descriptive-Comparative design is used.

The Sample and Locale of the Study

The sample of this study is the fourth-year pre-service teachers of the selected private schools in the fifth district of Leyte. Complete enumeration sampling was chosen as the appropriate technique due to the small number of teacher education enrollees in each private school. According to Abrol (2021), in a complete enumeration or census, the information is gathered from every member of the community. It is typically used for in-depth studies or situations when the population is small.

The locale of this study is the selected private colleges in the 5th District of Leyte. These private colleges are the Franciscan College of the Immaculate Conception (FCIC) of Baybay City, Leyte; Saint Michael College of Hindang, Leyte Inc.; and MLG College of Learning Inc. of Hilongos, Leyte. These private colleges offer a Bachelor's in Elementary Education and a Bachelor's in Secondary Education with majors in English, Filipino, Science, Social Studies, and Mathematics.

School	Course/Program	Target Population	Actual No. of Respondents
Franciscan College of the Immaculate Conception, Inc. (FCIC)	BEEd	10	2
	BSEd (English)	14	11
	BSEd (Filipino)	10	6
	BSEd (Mathematics)	3	0
MLG College of Learning Inc.	BEEd	32	29
	BSEd (Mathematics)	10	10
	BSEd (Social Studies)	62	53
Saint Michael College of Hindang, Leyte, Inc. (SMC)	BEEd	42	42
	BSEd (English)	72	64
	Total	254	217

Table 1. Distribution of Respondents

Research Instrument

The researcher adopted TPACK.xs instrument from the study of Schmid et al. (2020) as the survey questionnaire. A permission letter through email was sent to the author. The author is permitted to use the instrument, as long as there are proper citations. Schmid et al. (2020) states that TPACK.xs is a valid, reliable, and a generic scale instrument that is used to measure teacher knowledge with resource efficiency. Additionally, Magnanini & Morelli (2023) shows that TPACK.xs is applicable to larger populations. Moreover, Molgen, Asshoff & Hueckmann (2024) found out that TPACK.xs is a valid interpretation and reliable measurement of TPACK. Therefore, this study adapted TPACK.xs instrument since the study have large number of respondents. The instrument was modified by adding a socio-demographic profile as the first part. The survey instrument was created using Google Forms due to its flexibility, availability, and cost efficiency. The survey instrument was accessed using any operating system and device platform using the internet. Part I intends to gather the socio-demographic profile of the pre-service teachers' sex and major.

Part II is an adopted instrument from the study of Schmid et al. (2020) titled “Developing a short assessment instrument for Technological Pedagogical Content Knowledge (TPACK.xs) and comparing the factor structure of an integrative and a transformative model". The questionnaire contains 28 statements that they self-assessed their extent of knowledge of TPACK by placing a checkmark in the right column of the pre-service teachers' extent of knowledge of TPACK. The seven categories are Pedagogical Knowledge (PK), Content Knowledge (CK), Technology Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Technological Pedagogical Content Knowledge (TPACK) and rates each statement by points using a 5-point Likert scale where "1= No Knowledge", "2= Low Knowledge", "3=Average Knowledge", "4=Good Knowledge", "5=Strong Knowledge". A higher point indicated a strong knowledge of TPACK. Lastly, the respondents are asked to agree by placing a check on the consent statement at the end of the survey.

Range	Scale	Description	Interpretation
5	4.20 – 5.0	Very High	The pre-service teacher demonstrates knowledge in all the indicators of TPACK.
4	3.40 – 4.19	High	The pre-service teacher demonstrates knowledge in most of the indicators of TPACK.
3	2.60 – 3.39	Average	The pre-service teacher demonstrates knowledge in several of the indicators of TPACK.
2	1.80 – 2.59	Low	The pre-service teacher demonstrates knowledge of a few of the indicators of TPACK.
1	1.00 – 1.79	Very Low	The pre-service teacher demonstrates knowledge of a minimum of the indicators of TPACK.

Gathering of Data

The researcher asked for permission to conduct the study from the dean of the graduate school first. After the approval, a communication letter asking permission from the President or Directress to each private school was sent. Upon approval, the researcher asked permission from the dean of each school. After that, the researcher obtained the number of enrolled pre-service teachers from the registrar. Subsequently, the researcher conducted surveys at each private school according to the schedule. Orientation was conducted at the start of the survey. After the orientation, the researcher assisted the respondents in filling out the survey, then proceeded to collect the pre-service teachers' TPACK using Google Forms to measure their knowledge. The researcher monitored the Google sheet where the data was stored during the data gathering process. After gathering the data, the researcher downloaded the data from a Google sheet and applied statistical methods with the advice of a certified statistician to interpret the data.

In treating the data, this study used a Quantitative Descriptive Correlational Design. The socio-demographic profile of the pre-service teachers was described according to sex and major using the Frequency Distribution method. The extent of knowledge on TPACK was measured using a scale of 5, where 5 is Very High, 4 High, 3 Average, 2 Low, and 1 Very Low. The weighted mean was determined for each TPACK and categorized.

RESULTS AND DISCUSSION

Socio-Demographic Profile of the Pre-service Teachers as to Sex and Major

Attributes	Frequency	Percentage
Sex		
Female	158	73%
Male	59	27%
Total	217	100%
Major / Program		
BSEd Major in English	75	35%
Bachelor's in Elementary Education (BEEd)	73	34%
BSEd Major in Social Studies	52	24%
BSEd Major in Mathematics	10	5%
BSEd Major in Filipino	7	3%
Total	217	100%

Table 2. Socio-demographic profile of the pre-service teachers

Sex. Data show that the largest population of the pre-service teachers is female, which consists of 73%. This shows that the teacher education program of the selected private schools in the 5th District of Leyte is dominantly females. The result is supported by the study of Bongco & Abenes (2019), where secondary and elementary school teachers are mostly female in the Philippines. Also, this result aligns with the Commission on Higher Education report on the Statistical Bulletin for AY: 2023-2024, where the percentage of females in Teacher

Training consists of 74.7% while male is 25.3% in the population. A similar result by the study of Ramos et. al. (2020) shows that the majority of the pre-service teachers were female.

Major / Program. The teacher education program has several majors. In this study, the majors offered in the private schools in the 5th District of Leyte include Bachelor of Elementary Education and Bachelor of Secondary Education majors in English, Filipino, Social Studies, and Mathematics. As shown in Table 2, the highest number of students chose the Bachelor of Secondary Education major in English, which comprised 35% of the population. This result is attributed to the fact that all three selected private colleges offer an English major. This resulted in most of the respondents being English majors. This result is supported by the study of Beal (2020), who contends that majoring in English results in people who are immediately employable, which is a desired consequence for institutions of higher learning, the arts, and the government. Study of Garza-Rodriguez (2022) shows that personal and professional aspects, as well as biographical experiences, influence students to choose English teaching.

As to the lowest percentage of students taking majors, it can be gleaned from the Table that Filipino has 3%. This result is attributed to the fact that of the three selected private schools, only one school offers a Filipino major with 10 students, and only three students participated in the study. With regards to majoring in Mathematics, which has 5%, this data is based on the only college from the selected colleges that participated in the study. This result is in connection with the List of CHED 2024 priority courses, where the Bachelor of Secondary Education Major in Science and Mathematics is a national priority program, and the Bachelor of Secondary Education majors in Filipino and Social Science are regional priority programs in Region 8.

Extent of Pre-service Teachers' Knowledge of Technology, Pedagogy, and Content

Indicators	Weighted Mean	Extent of Knowledge
Content Knowledge (CK)		
CK1. I have sufficient knowledge about my teaching subject.	3.40	High
CK2. I can use a subject-specific way of thinking in my teaching subject.	3.32	Average
CK3. I know the basic theories and concepts of my teaching subject.	3.31	Average
CK4. I know the history and development of important theories in my teaching subject.	3.23	Average
Overall	**3.32**	**Average**

Table 3.1. Distribution of the extent of pre-service teachers' Content Knowledge on TPACK

The result presented in Table 3.1, with a mean of 3.32, described as "Average," means that the pre-service teacher demonstrates knowledge in several of the indicators of TPACK. This result is attributed to the fact that of the four indicators, three were rated average and one was rated high. This result is similar to the study of Dwi et. al. (2024) that pre-service teachers'

Content Knowledge is in the "Medium" category, for which improvement is required. This implies that pre-service teachers in the selected private schools have a sufficient extent of knowledge in Content but need improvement.

The findings indicate that pre-service teachers demonstrated average in Content Knowledge, which means they demonstrate knowledge in several of the indicators of TPACK. Pre-service teachers are well-versed in the subject that they are teaching, but there is room for improvement, especially in applying subject-specific thinking, incorporating core theories and concepts into their teaching practices, and raising awareness of the historical development of key theories in their subject matter. This implies that pre-service teachers may need to enhance their ability to apply subject-specific thinking, integrating essential theories and concepts into lesson plans, and gaining a deeper understanding of the historical context and evolution of those theories. Teacher education programs could focus on providing more opportunities for pre-service teachers to engage with the theoretical foundations of their subject, incorporate research-based teaching strategies, and explore the historical and conceptual developments within their field.

Indicators	Weighted Mean	Extent of Knowledge
Pedagogical Knowledge (PK)		
PK1. I can adapt my teaching based on what students currently understand or do not understand.	3.44	High
PK2. I can adapt my teaching style to different learners.	3.54	High
PK3. I can use a wide range of teaching approaches in a classroom setting.	3.41	High
PK4. I can assess student learning in multiple ways.	3.45	High
Overall	**3.45**	**High**

Table 3.2. Distribution of the extent of pre-service teachers' Pedagogical Knowledge of TPACK

Data in Table 3.2 shows a descriptive statistic of the pre-service teachers' extent of knowledge in terms of Pedagogical Knowledge (PK). The pre-service teachers' Pedagogical Knowledge (PK), described as high with a mean of 3.45, means that the pre-service teachers demonstrate knowledge in most of the indicators of TPACK because all indicators were rated high. It implies that they are prepared to adapt to students' learning needs, using diverse teaching methods, and assessing student learning. Demonstrating high Pedagogical Knowledge is significant for pre-service teachers to effectively deliver the lesson. This result is similar to the study of Bwalya & Rutegwa (2023) and Santos & Castro (2021), which found that the pre-service teachers' Pedagogical Knowledge (PK) is high.

The results indicate that the pre-service teachers have a high extent of knowledge in Pedagogy. Pre-service teachers are prepared to create effective, student-centered learning environments. Their deep understanding of pedagogical theories and strategies enables them to design well-structured lessons that cater to diverse learning styles and needs, ensuring that all students can engage meaningfully with the content. It implies that with the high extent of

knowledge in Pedagogy, pre-service teachers are well-prepared to effectively implement teaching strategies and enhance student learning outcomes.

Indicators	Weighted Mean	Extent of Knowledge
Technological Knowledge (TK)		
TK1. I keep up with important new technologies.	3.82	High
TK2. I frequently play around with the technology.	3.61	High
TK3. I know about a lot of different technologies.	3.48	High
TK4. I have the technical skills I need to use technology.	3.38	Average
Overall	**3.70**	**High**

Table 3.3. Distribution of the extent of pre-service teachers' Technological Knowledge of TPACK

Data show that the extent of knowledge of Technology is High with a mean of 3.70, which means that the pre-service teachers demonstrate knowledge in most of the indicators of TPACK. Of the four indicators, three were rated high and only one average. This result shows that pre-service teachers may have a notably high extent of knowledge in Technology. This result is supported by the study of Febliza et. al. (2023), who contend that the younger generation of pre-service teachers has higher levels of digital literacy. Meaning, they are better equipped to integrate multimedia resources, interactive platforms, and online assessments into their lessons, making learning more dynamic and accessible for diverse student populations. The same result by the study of Santos & Castro (2021) reveals that pre-service teachers have strong knowledge in Technology, and also have a mean of 3.70.

The results indicate that pre-service teachers' extent of knowledge in Technology is high. It means that the pre-service teachers demonstrate knowledge in most of the indicators of TPACK. It implies that pre-service teachers have a high extent of knowledge in Technology, but they still need to improve their technical skills. This finding aligns with the study of Akaadom (2020) that pre-service teachers may need more training on technical skills to utilize technology effectively because computer technical skills training is not included in the curriculum. This disparity may inform teacher education programs that technical training must be provided to pre-service teachers to effectively utilize technology.

Summary of the Pre-Service Teachers' TPACK

Indicators	Mean	Extent of Knowledge
Content Knowledge (CK)	3.32	Average
Pedagogical Knowledge (PK)	3.45	High
Technological Knowledge (TK)	3.70	High
Overall	**3.49**	**High**

Table 4. Summary of Pre-service Teachers' TPACK

Data shows that the highest extent of knowledge is in Technology, which has a mean of 3.70. It means that the pre-service teacher demonstrates knowledge in most of the indicators of TPACK. The result shows that pre-service teachers have a high extent of knowledge when it comes to technology. It implies that the three selected private colleges provided good training in Technology to pre-service teachers. This result is supported by the study of Susanti et. al. (2023), who state that modern teacher education programs resulted in the high knowledge of pre-service teachers in technology. The second-highest extent of knowledge is Pedagogy, which has a mean of 3.45. It means that the pre-service teacher demonstrates knowledge in most of the indicators of TPACK. The result shows that pre-service teachers in the selected private colleges have a high extent of knowledge of Pedagogy. It implies that pre-service teachers can design and deliver lessons that cater to diverse student needs, engage learners, and foster a positive learning environment. This result is similar to the study of Iqbal et. al. (2022) that pre-service teachers' Pedagogical Knowledge (PK) has higher scores.

The findings indicate that pre-service teachers in the selected private colleges have a high extent of knowledge in Technology and Pedagogy, while the extent of knowledge in Content is average, indicating that pre-service teachers may have a moderate understanding of their content. Suggesting improvement in their depth and mastery of the content. Overall, the pre-service teachers demonstrate knowledge in most of the indicators of TPACK.

Differences in the extent of knowledge of pre-service teachers in Content, Pedagogy, and Technology

Knowledge	Extent of Knowledge					Total
	Very Low	Low	Average	High	Very High	
Content	1	7	119	79	11	217
Pedagogy	0	7	101	89	20	217
Technology	0	9	78	100	30	217
Total	**1**	**23**	**298**	**268**	**61**	**651**

χ^2-value = 22.207**; df =8; p-value=0.005; **Highly Significant

Table 5. Differences in the extent of knowledge of pre-service teachers in terms of Content, Pedagogy, and Technology

The data show that significant differences were highly revealed among the three groups due to the Chi-square test statistic of 22.207, with a p-value of 0.005. A p-value below 0.01 indicates that the observed differences in the extent of knowledge across Content, Pedagogy, and Technology are unlikely to have occurred by chance. This means that there is a meaningful and consistent variation in how pre-service teachers rate their knowledge in these areas. The result also shows differing distributions, with Technology having a notably higher proportion of teachers rated as "High" and "Very High" compared to Content and Pedagogy. The significance reinforces the idea that these differences are not random but reflect real differences in the knowledge levels across the three domains. It implies that understanding how these areas are related to each other may help identify the need for further focus or development in teacher education programs. This result is supported by the study of Jiang et. al. (2024), who contend that there is an extremely significant difference in each TPACK dimension. Moreover, a similar

result by the study of Irwanto et. al. (2022) showed that a highly significant correlation existed in all domains of TPACK.

The findings of this study, as indicated by the Chi-square test, suggest that there is a statistically significant difference in the pre-service teachers' knowledge in Content, Pedagogy, and Technology. It means that the differences in the way they evaluate their knowledge across the knowledge areas are not due to random chance. The pre-service teachers' knowledge in these areas differs in a meaningful way. It implies that there is a need for a more balanced curriculum that places equal emphasis on content knowledge to ensure that pre-service teachers are well-prepared in all areas of teaching. Teacher education programs may need to re-evaluate their approach to all domains in Content, Pedagogy, and Technology to adequately address and foster pre-service teachers. Although this study found significant differences among the three knowledge, future research could investigate the longitudinal phenomena of this result.

Relationship between the socio-demographic profile and the extent of pre-service teachers' knowledge in Content, Pedagogy, and Technology.

Profile	TPACK Knowledge	Chi-square Value	df	Contingency Coefficient	p-value	Significance
Sex	Content (CK)	3.586	4	0.128	0.465	Not Significant
	Pedagogical (PK)	4.298	4	0.139	0.367	Not Significant
	Technological (TK)	5.643	4	0.227	0.159	Not Significant
Major	Content (CK)	34.540	16	0.371	0.005	Significant
	Pedagogical (PK)	22.308	16	0.305	0.134	Not Significant
	Technological (TK)	19.634	16	0.288	0.237	Not Significant

Table 6. Relationship between the socio-demographic profile of the pre-service teachers and their extent of knowledge in Content, Pedagogy, and Technology

Sex. Table 6 shows the relationship between the Sex of pre-service teachers and their extent of knowledge in Technological Pedagogical Content Knowledge (TPACK) across three domains: Content (CK), Pedagogical (PK), and Technological (TK). For all three domains (CK, PK, TK), the chi-square values indicate no significant relationship between sex and TPACK knowledge, as evidenced by the p-values being greater than 0.05 (0.465, 0.367, and 0.159, respectively). Therefore, sex does not appear to be a determining factor or does not affect the extent of knowledge that pre-service teachers have in these areas of TPACK, suggesting that male and female pre-service teachers have similar levels of understanding in content, pedagogy, and technology. Similar results from the study of Nautiyal & Dabral (2023) showed that sex has no significant relationship in all TPACK domains and stated that sex has no significant impact on TPACK based on other studies.

Major. Table 6 indicates a significant relationship between the major of pre-service teachers and their knowledge in the Content Knowledge (CK) of TPACK, with a chi-square value of 34.540 and a p-value of 0.005, which is below the 0.05 threshold for significance. This suggests that the pre-service teachers' major influences their extent of knowledge in Content. However, no significant relationships were found between their major and their extent of knowledge in Pedagogy and Technology, as the p-values for both are above 0.05 (0.134 and

0.237, respectively). A similar study of Sherab et. al. (2022) shows that the course (major) has a significant difference in Content Knowledge (CK) and Pedagogical Knowledge (PK), and Technological Knowledge (TK) significance is only marginal. Another study conducted by Bwalya & Rutegwa (2023) reveals that pre-service teachers' subject specialization has no influence on their TPACK, but there is a difference in Technological Pedagogical Knowledge (TPK). In this context, the pre-service teacher's major affects their extent of knowledge in Content but not in Pedagogy and Technology.

The findings of this study indicate that Sex does not influence the extent of knowledge in Content, Pedagogy, and Technology. Regardless of Sex, their extent of knowledge is almost all the same. Major does not influence their extent of knowledge in Pedagogy and Technology, but there is a significant relationship or influence on their extent of knowledge in Content. This implies that Sex does not affect their understanding or expertise in these areas. In Major, curriculum and specialized training associated with a particular major will directly contribute to the depth of knowledge that pre-service teachers acquire in their area of focus. Given the relationship between Content Knowledge and the pre-service teachers' major, future research could examine the causal relationship between Major and Content Knowledge.

Proposed Training Program

The proposed training program on the pre-service teachers' Technological Pedagogical and Content Knowledge (TPACK) is designed to address the content areas that need improvement. The program consists of a series of training activities that strengthen the pre-service teachers' Content knowledge and develop technical skills. The training program will be delivered through various approaches for an enriched learning experience. Based upon the results found in this study, it has been concluded that a training program is appropriate for pre-service teachers to enhance their knowledge in Content and develop technical skills. The training program offers enriched sequential development of skills, reinforcement of key concepts, and the opportunity to practice over an extended period.

CONCLUSION

Summary of Findings

The pre-service teachers' socio-demographic profile, the largest population of the pre-service teachers are female, which consists of 73% while male consists of 27%. As for Major, the largest population is major in English with a population of 35% followed by Elementary Education 34%, and Social Studies 24% while the lowest population is major in Mathematics 5% and Filipino 3%. Analysis of the extent of pre-service teachers' knowledge in Content, Pedagogy, and Technology showed that the extent of knowledge in Content is average with a mean of 3.32, Pedagogy is high with a mean of 3.45, and Technology is the highest extent with a mean of 3.70, but average in technical skills. Analysis of the significant difference in the knowledge of pre-service teachers in terms of Content, Pedagogy, and Technology showed that there is a statistically significant difference in the pre-service teachers' knowledge in Content, Pedagogy, and Technology.

Analysis in the significant relationship between the socio-demographic profile of the pre-service teachers' and the extent of pre-service teachers' knowledge in terms of Content Knowledge (CK); Pedagogical Knowledge (PK); and Technological Knowledge (TK) showed that that socio-demographic profile of pre-service teachers in terms of Sex has no significant relationship to their extent of knowledge in Content, Pedagogy, and Technology while Major has no significant relationship in the extent of knowledge in Pedagogy and Technology but there is a significant relationship to the extent of knowledge in Content.

Conclusion

In conclusion, the disparity in sexes among pre-service teachers reflects broader societal factors that influence career choices. Ensuring a balance of sexes in the teaching profession can provide role models that benefit and meet the needs of students and society. Moreover, the findings suggest that pre-service teachers possess a strong understanding of Technology and Pedagogy, reflecting the growing emphasis on integrating modern teaching tools and methodologies in teacher education programs. However, their knowledge of Content is average, indicating a potential area for improvement. This suggests that while pre-service teachers are well-equipped to navigate and apply teaching strategies and technology, further focus on deepening subject-specific expertise may be necessary. Strengthening content knowledge could enhance their overall teaching effectiveness, ensuring they are well-rounded educators capable of delivering high-quality education in both subject matter and instructional techniques. A balanced approach that strengthens both content knowledge and pedagogical skills will ultimately contribute to better outcomes for students.

Recommendations

The recommendations based upon the results of this study are as follows:

1. Create an advocacy campaign to motivate male teachers in the teaching profession.
2. Deepen the understanding of the role of teachers in teaching Filipino and Mathematics in the Basic Education Curriculum.
3. Balanced approach that strengthens both content knowledge and pedagogical skills to contribute to better outcomes for students.
4. Include performance-based assessments such as Classroom Observations would help determine the pre-service teachers' TPACK.
5. Adopt the proposed training program.

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