# ASSESSING THE TECHNOLOGICAL, PEDAGOGICAL, AND CONTENT KNOWLEDGE OF PRE-SERVICE MATHEMATICS TEACHERS: BASIS FOR DESIGNING A TRAINING PROGRAM

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**ABSTRACT**

*Pre-service teaching is a major requirement for the teacher education course that prepares students to become professional teachers in the future. This paper aimed to look into the technological, pedagogical and content knowledge of the twenty (20) pre-service teachers teaching Mathematics utilizing a descriptive-survey method with the aid of a standardized test and the modified observation tool in gathering the needed information. The study revealed that the pre-service teachers were average in content knowledge and outstanding in pedagogical knowledge. However, they were found unsatisfactory in technological knowledge. It was disclosed further that a significant difference existed between the pedagogical and content knowledge, and between the pedagogical and technological knowledge while content and technological knowledge of the respondents did not significantly differ. This study concluded that the respondents were not ready in terms of content having insufficient knowledge in most topics with lowest in Geometry 1, very ready in terms of pedagogical knowledge having a very high level of readiness when it comes to the different strategies of teaching content and how these knowledge could be appropriately transferred to the learners, and less ready in technological knowledge lacking skills in handling technological devices especially on the process that are necessary for discussion and lack extension of discussion with the use of multi-media, social media, schoology, google classroom and others. Hence, this study recommended the instructors of SUCs to provide adequate learning experiences to their students in handling technological devices such as the use of multi-media, social media, schoology, google classroom and others. They may provide review classes to students to help recall mathematical concepts which could fortify mastery on solving mathematical problems. Further, a seminar and training workshop for the pre-service teachers on the use of ICT in classroom instruction was recommended.*

**Keywords:** *technological, pedagogical, content knowledge, pre-service teachers, training program*

## 1. INTRODUCTION

Pre-service teaching is known as off-campus training of the teacher education students in the final year of their course. It is a major requirement for the teacher education course that prepares students to become professional teachers in the future. It is during the practicum that pre-service teachers develop their teaching skills, integrate theories in teaching, experiment with novel teaching approaches different from what they have learned when they were students themselves and become professional teachers someday. By that time, they all become prime molders of the citizens in our nation. It is important to provide them with the best practicum experience that will develop them into a competent, highly qualified, professional teachers of the country.

Teaching mathematics requires a deep understanding of the principles and theories behind every single problem. As a teacher, it is important to have a profound understanding of the subject matter before the knowledge could be successfully transferred to the learner. However, teaching-learning process does not only depend on the teachers'

knowledge of the content alone, it requires knowledge on how to deliver it, incorporating strategies that enhances students to learn the mathematical content. These strategies and approaches utilized in teaching mathematics is a vital knowledge that pre-service teachers must learn in order to become efficient educators in the future. According to Luik, Suviste and Taimalu (2018) [1], most countries stress that training quality educators for 21st century students is a necessary task for institutions. Besides the abilities on ways of teaching the subjects effectively, educators must also learn the ways of integrating digital technology into their teaching.

However, these are not very evident in most of the Bachelor of Secondary Education major in Mathematics pre-service teachers deployed in Dipolog City Division as observed by the cooperating teachers. There are those who possess low communication skills necessary for teaching, lacked scaffolding techniques, and insufficient teaching strategies that will boost the interest of the students to learn Mathematics. As a cooperating teacher for eight (8) years, the researcher confirmed the same.

In fact, Ponggan (2018) [2] observed that during the conduct of Regional Mass Training of Teachers (MTOT) teaching Statistics and Probability, there were trainee-teachers who were neophytes to teaching the course. Moreover, Bacabac and Roble (2016) [3] revealed that pre-service teachers were proficient with mathematics content but not fully equipped with all the necessary teaching skills. Lee and Lovett (2017) [4] exposed that secondary mathematics pre-service teachers were not well prepared to teach statistics. Specific suggestions were given for how teacher education programs must rise to the challenge of preparing their graduates to teach statistics. Madinno (2018) [5] showed the lack of readiness of the secondary Mathematics pre-service teachers in teaching mathematics based from the national frameworks of math teacher education and basic education in the country.

With the above scenario, the researcher was motivated to conduct this study to determine the readiness of the Bachelor of Secondary Education major in Mathematics pre-service teachers in teaching. The results of this study became the bases for determining what specific skills needed to be further developed among the pre-service teachers and for enhancing or redesigning a program that will help pre-service teachers be prepared for the challenges of the present prescribed curriculum. Moreover, this study assessed the technological, pedagogical, and content knowledge of pre-service mathematics teachers as a bases for designing a training program. This study limited its focus on determining the readiness of the pre-service Math teachers in teaching. The respondents of the study were limited to the Bachelor of Secondary Education major in Mathematics pre-service teachers of Jose Rizal Memorial State University, who were deployed in Dipolog City Schools Division.

**1.1 Problem Statement**

This present study sought to answer the following questions to determine the readiness of the Bachelor in Secondary Education major in Mathematics pre-service teachers of Jose Rizal Memorial State University, deployed in the high schools of Dipolog City Division during the second semester of the school year 2018-2019.

1. What is the level of readiness of the pre-service teachers on content knowledge in terms of:
    - 1.1 Solving Equations;
    - 1.2 Advanced Algebra;
    - 1.3 Ratio and Proportion;
    - 1.4 Sequence and Series;
    - 1.5 Algebra;
    - 1.6 Geometry 1;
    - 1.7 Geometry 2;
    - 1.8 Coordinate Geometry;
    - 1.9 Exponents, Radicals, and Logarithms;
    - 1.10 Probability and Statistics;
    - 1.11 Percentage Problems;
    - 1.12 Problems Involving Fractions.
2. What is the level of readiness of the pre-service teachers on pedagogical knowledge?
3. What is the level of readiness of the pre-service teachers on technological knowledge?
4. Is there a significant difference on the level of readiness of the pre-service teachers along content knowledge, pedagogical knowledge and technological knowledge?
5. What training program can be proposed based on the results of the study?

**1.2 Hypothesis**

$Ho_1$: There is no significant difference on the level of readiness of the pre-service teachers along content knowledge, pedagogical knowledge and technological knowledge.

**1.3 Theoretical Framework of the Study**

This study was anchored on the Technological (T) Pedagogical (P) Content (C) Knowledge (K) Framework of Mishra and Koehler (2006) [6]. This TPACK model supported Shulman's (1986) PCK (pedagogical content knowledge) theory with the addition of technology.

Analysis inside the realm of technological education has frequently been criticized for an inadequate theoretical grounding. Mishra and Koehler suggested an abstract framework for educational technology by formulating a plan from Shulman's pedagogical content knowledge by adding technology integrated into the teachers' pedagogy. Mishra and Koehler (2006) believed that this model has a lot to grant to the discussions of technology integration at multiple levels: theoretical, pedagogical, and methodological.

The advent of digital technology has dramatically modified routines and practices in most arenas of human work. Advocates of technology in education usually envision similar dramatic changes within the method of teaching and learning Mishra and Koehler (2006).

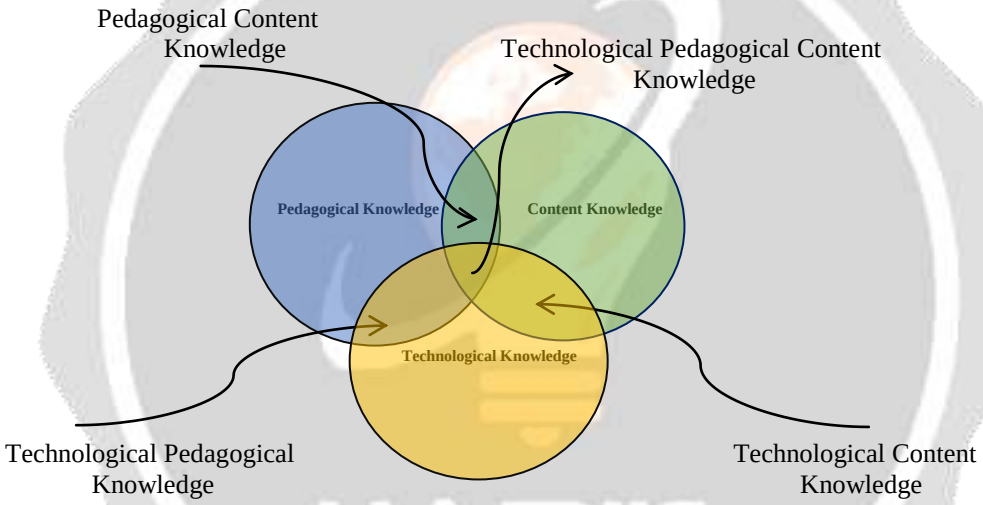


**Fig- 1** Technological Pedagogical Content Knowledge Framework. Adopted from Mishra and Koelher (2006)

Figure 1 presents the definition of each knowledge construct in the TPACK model, including PK (pedagogical knowledge), CK (content knowledge), and TK (technological knowledge). The figure highlights the connections, interactions, affordances, and constraints between and among content(C), pedagogy(P), and technology(T) as central to developing quality teaching. However, instead of treating these as separate bodies of information or knowledge, this model in addition emphasizes the complicated interaction of those 3 bodies of information or knowledge.

However, the current study focused only on investigating the content knowledge, pedagogical knowledge, and technological knowledge as central component in developing good and quality teaching. The researcher wanted to find out if a pre-service teacher with sufficient mathematical knowledge could impart this knowledge utilizing different techniques and approaches appropriate to how the content is supposed to be taught or if a teacher would be able to integrate appropriate technology to a lesson when he or she is sufficiently knowledgeable on the mathematical content. Moreover, the study aimed to determine if a pre-service teacher with profound knowledge on the content could facilitate this knowledge using technological devices in teaching and incorporate these digital technologies in the teaching and learning process. The investigation did not include the other constructs of the TPCK model.

**1.4 Conceptual Framework of the Study**

Figure 2 emphasizes the interplay between pedagogical and content knowledge which is about understanding the best practices for teaching specific content to specific students; the interplay between technological and content knowledge which is about knowing how the digital tools available can enhance or transform the content and how it is delivered to students and how your students can interact with it; and the interplay between technological and pedagogical knowledge which is about understanding how to use your digital technologies as a vehicle to the learning outcomes and experiences you want.

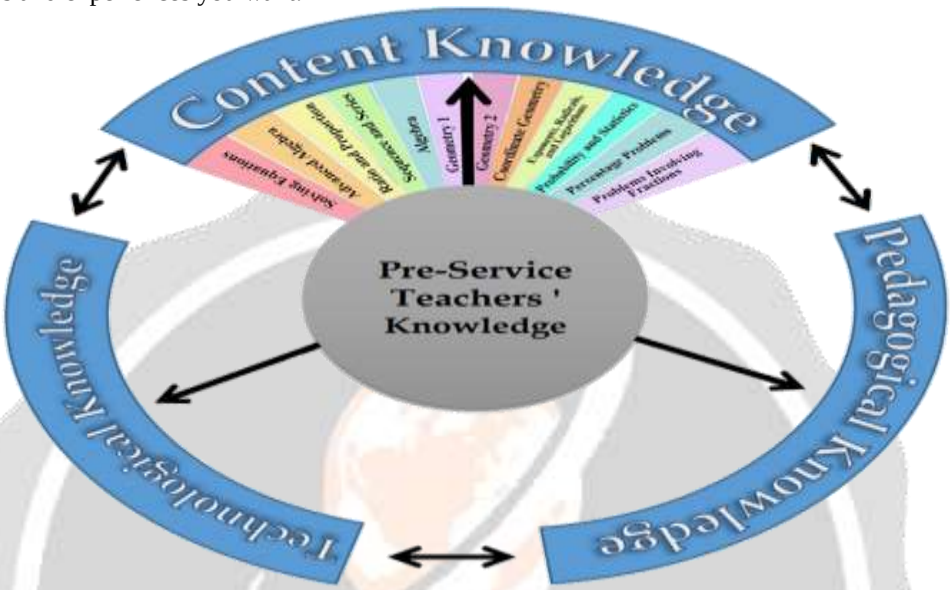


**Fig- 2** The Conceptual Framework of the Study

**Content Knowledge(CK)** is identified as the knowledge concerning the particular subject matter or topic that's to be taught or learned Mishra and Koehler (2006). Heritage and Vendlinski, (2006) [7] articulated that teachers' background subject knowledge directly influences student achievement. Rosas and West (2011) [8] averred that there was a lack of specific information which linked mathematical coursework and content completed by the teachers during their teacher preparation programs to students' mathematical achievement. Rosas & Campbell's (2010) [9] found that pre-service educators had a definite understanding of mathematics.

Content knowledge in this study comprises of (a) Solving Equations; (b) Advance Algebra; (c) Ratio and Proportion; (d) Sequence and Series; (e) Algebra, (f) Geometry 1; (g) Geometry 2; (h) Coordinate Geometry : (i) Exponents, Radicals, and Logarithms, (j) Probability and Statistics; (k) Percentage Problems; and (l) Problems Involving Fractions.

**Pedagogical Knowledge** is defined as the deep knowledge about the processes and practices or methods of teaching and learning and the way it encompasses, among different things, overall academic functions, values, and aims Mishra & Koehler (2006). However, Clift and Brady as cited in Rosas and West (2011) found that cooperating teachers understanding of standard-based instruction improved through their experiences with pre-service teachers. The investigation indicated more a uniform theme of a paradigm shift from the teacher as the "authority and knowledge provider to teacher as facilitator". Such contrastive findings clearly indicate that a lot of in-depth investigation, that directly connects teacher preparation to student accomplishment, is required within the field of mathematical instruction.

In this study, pedagogical knowledge of pre-service teachers was measured with the use of the following indicators: (a) uses a range of teaching strategies that enhance learner achievement in literary and numeracy skills; (b) applies range of teaching strategies to develop critical and creative thinking, as well as other higher-order thinking skills; (c) manages classroom structure to engage learners individually or in groups, in meaningful exploration, discovery and hands-on activities within a range of physical learning environments; (d) manages learner behaviour constructively

by applying positive and non-violent discipline to ensure learning focused-environment; (e) uses differentiated, developmentally appropriate learning experiences to address learners' gender, needs, strength, interests and experiences; (f) plans, manages and implements developmentally sequenced teaching and learning processes to meet curriculum requirements and varied teaching contexts; (g) designs, selects, organizes and uses diagnostic, formative and summative assessment strategies consistent with curriculum requirements; (h) applies knowledge of content within and across teaching areas.

**Technological Knowledge** is defined as the knowledge about standard technologies, such as the use of laptop, computers, projectors, spreadsheets, chats, emails, computer software, and a more advanced technologies, such as the Internet and digital video, which includes blogging, schoology, google classroom, Edmodo, and other webpages Mishra and Koehler (2006).

According to Mishra and Koehler (2006), technological knowledge involves the skills required to operate particular technologies. Moreover, Ghavifekr and Rosdy (2015) [10] indicated that ICT integration is very effective for both the educator and the learners. Teachers' well-equipped preparation with ICT tools and facilities is one of the core factors in success of technology-based teaching and learning. Additionally, it was also found that professional development training programs for teachers also contend a key role in enhancing students' quality learning.

In this study, technological knowledge was measured with the use of the following indicators: (a) Selects, develops, organizes and uses appropriate teaching and learning resources including ICT to address learning goals; (b) Shows expertise in handling of the technological devices used in teaching; (c) Uses technology in communicating with the learners as an extension to discussion.

In this investigation, the TPACK provides a means to measure the level of readiness of the BSED Math pre-service teachers.

## 2. RESEARCH METHODOLOGY

The descriptive survey method of research was used in this study. The respondents of the study were the twenty (20) Bachelor in Secondary Education Math pre-service teachers of Jose Rizal Memorial State University who had their final practicum in the public secondary schools in Dipolog City Division during the second semester of the School Year 2018-2019. After the approval of all letters, the researcher together with one (1) inter –rater conducted an unannounced observation to the Bachelor in Secondary Education- Math pre-service teachers. This study utilized an instrument based on the TPCK Framework. It consisted of two parts. The first part was a standardized test measuring the content knowledge of each pre-service teacher in terms of : (a) Solving Equations; (b) Advanced Algebra; (c) Ratio and Proportion; (d) Sequence and Series; (e) Algebra; (f)Geometry 1; (g) Geometry 2; (h) Coordinate Geometry; (i) Exponents, Radicals, and Logarithms; (j) Probability and Statistics; (k)Percentage Problems; and (l) Problems Involving Fractions.

The second part was the modified classroom observation tool developed through the Philippine National Research Center for Teacher Quality (RCTQ) with support from the Australian Government through the Basic Education Sector Transformation (BEST) Program. It measured the pedagogical knowledge, and technological knowledge.

To draw out the level of readiness of the pre-service teachers on the content knowledge in terms of each indicator, a 5- point Likert type scale format was utilized with the indicated qualitative description and interpretation as follows:

| Scale | Range of Values | Description | Interpretation |
|---|---|---|---|
| 5 | 8.81 – 10.00 | Excellent | Very Ready |
| 4 | 6.61 – 8.80 | Above Average | Ready |
| 3 | 4.41 – 6.60 | Average | Moderately Ready |
| 2 | 2.21 – 4.40 | Below Average | Less Ready |
| 1 | 0.00 – 2.20 | Poor | Not Ready |

To draw out the level of readiness of the pre-service teachers in terms of pedagogical and technological knowledge, the five point Likert type scale format was employed with the indicated qualitative description and interpretation follows:

| Scale | Range of Values | Description | Interpretation |
|---|---|---|---|
| 5 | 4.21 – 5.00 | Outstanding | Very Ready |
| 4 | 3.41 – 4.20 | Very satisfactory | Ready |
| 3 | 2.61 – 3.40 | Satisfactory | Moderately Ready |
| 2 | 1.81 – 2.60 | Unsatisfactory | Less Ready |
| 1 | 1.00 – 1.80 | Poor | Not Ready |

Raw data obtained by the pre-service teachers was converted to its 5-point Likert equivalent for uniformity of all the data in the content, pedagogical and technological knowledge before treating the data statistically.

Frequency counting was used to determine the frequency of every item in the technological, pedagogical, and content knowledge. Mean was employed to find out the level of readiness of the pre-service teachers' content knowledge, pedagogical knowledge, and technological knowledge. Standard Deviation was used to quantify the amount of variation or dispersion of a set of data values along data on content, pedagogical and technological knowledge. Friedman's Test was used to establish the significant difference on the readiness of the pre-service teachers in teaching on the content, pedagogical, and technological knowledge. Post Hoc Analysis was used to determine the significant difference between content knowledge and pedagogical knowledge, between content knowledge and technological knowledge, and between pedagogical knowledge and technological knowledge since the result using Friedman's test was significant. Wilcoxon Signed Rank Test was the statistical tool used. SPSS Statistics Version 20 was the software packaged used in treating the significant difference along with content knowledge, pedagogical knowledge, and technological knowledge. Statistical test was performed at 0.05 level of significance.

## 3. RESULT AND DISCUSSION

**Table 1** Level of Readiness of Pre-service Teachers' Content Knowledge

| Content Knowledge Indicators | Mean Score | Description | Interpretation |
|---|---|---|---|
| Solving Equation | 7.45 | Above Average | Ready |
| Advance Algebra | 5.80 | Average | Moderately ready |
| Ratio and Proportion | 4.05 | Below Average | Less Ready |
| Sequence and Series | 4.40 | Below Average | Less Ready |
| Algebra | 5.50 | Average | Moderately Ready |
| Geometry 1 | 3.20 | Below Average | Less Ready |
| Geometry 2 | 5.00 | Average | Moderately Ready |
| Coordinate Geometry | 4.90 | Average | Moderately Ready |
| Exponents, Radicals, and Logarithms | 3.65 | Below Average | Less Ready |
| Probability and Statistics | 5.30 | Average | Moderately Ready |
| Percentage Problems | 4.05 | Below Average | Less Ready |
| Problem Involving Fractions | 3.30 | Below Average | Less Ready |
| **Grand Mean** | **4.72** | **Average** | **Moderately Ready** |

As shown on the table, the Bachelor in Secondary Education-Math Pre-service Teachers obtained a grand mean of 4.72 which was described as Average. For this study, this means that the respondents were moderately ready to teach the topics in teaching Mathematics. However, based on university standard the pre-service teachers were not ready to teach in terms of mathematical content.

Findings also revealed that among the indicators, the respondents got above average on only one topic in content knowledge which was solving equations. Additionally, pre-service teachers got average on subjects like advanced algebra, algebra, geometry 2, coordinate geometry and probability and Statistics but obtained below average on most topics like problem involving fractions, percentage problems, exponents, radicals and logarithms, ratio and proportions, sequence and series having the lowest in Geometry 1. This means that the respondents showed poor

performance in answering questions in these topics of Mathematics indicating that the pre-service teachers have insufficient knowledge on most of the topics in content knowledge.

In the study of Özerem (2012) [11] weaknesses of students at geometry questions to answer the measures, angles and shapes, transformations and construction and 3-D shapes in his study on the misconceptions in Geometry were found. The results from this study unconcealed that students have variety of misconceptions, lack of background information, reasoning and basic operation mistakes at the above mentioned topics. Further, Yahya, Hershkowitz, and Dreyfus (2017) [12] found out that students couldn't remember the formulas after the exams because they just memorized them for the exams in short term memory not in long term memory.

This result was also similar in the study of Seifi, Haghverdi, Azizmohamadi (2012) [13] detecting students' difficulties in solving mathematical word problems from their teachers' perspectives. The results showed that the students' difficulties mostly sprung from their disabilities in representation and understanding of word problems, making a plan and defining the related vocabularies. The findings disclosed that, the causes of the learner difficulties were text difficulties, unacquainted with contexts in mathematical challenges and employing inappropriate methods. Finally educators concluded to assist students in teaching them find for a pattern, draw an image and rewriting the problems. According to Siniguian (n.d.) [14] students' difficulties were on the inability to translate problem into mathematical form and inability to use correct mathematics. Accordingly, Mulwa (2015) [15] showed that students have difficulties in using mathematical terms and their related concepts. Moreover, Sarwadi and Shahrill (2014) [16] conveyed that students' errors are causally determined, and very often systematic. Systematic errors were usually a consequence of student misconceptions. These may compose of failure to create connections with what they already understand.

This implies that teachers may motivate students to learn the essential concepts on these topics especially in Geometry 1, and may inculcate problem solving ability among students' through different techniques, and must address these difficulties so that students will develop skills geometrically. Varied and engaging activities may be given to students, and that formulae and problem solving may be learned via applying and experiencing by the students. Moreover, review classes maybe done to help recall mathematical concepts which could fortify mastery on solving mathematical problems.

**Table 2** Level of Readiness of Pre-service Teachers Pedagogical Knowledge

| Indicators | Mean Score | Description | Interpretation |
|---|---|---|---|
| 1.uses a range of teaching strategies that enhance learner achievement in literary and numeracy skills; | 4.46 | Outstanding | Very Ready |
| 2.applies range of teaching strategies to develop critical and creative thinking, as well as other higher order thinking skills; | 4.20 | Very Satisfactory | Ready |
| 3.manages classroom structure to engage learners, individually or in groups, in meaningful exploration, discovery and hands-on activities within a range of physical learning environments; | 4.24 | Outstanding | Very Ready |
| 4.manages learner behaviour constructively by applying positive and non-violent discipline to ensure learning-focused environment; | 4.44 | Outstanding | Very Ready |
| 5.uses differentiated, developmentally appropriate learning experiences to address learners' gender, needs, strength, interests, and experiences; | 3.82 | Very Satisfactory | Ready |
| 6.plans, manages and implements developmentally sequenced teaching and learning processes to meet curriculum requirements and varied teaching contexts; | 4.30 | Outstanding | Very Ready |

| | | | |
|---|---|---|---|
| 7.designs, selects, organizes, and uses diagnostic, formative and summative assessment strategies consistent with curriculum requirements; | 4.07 | Very Satisfactory | Ready |
| 8.applies knowledge of content within and across teaching areas. | 4.59 | Outstanding | Very Ready |
| **Grand Mean** | **4.27** | **Outstanding** | **Very Ready** |

As seen on the table, the respondents got a grand mean of 4.27 which was described in this study as outstanding. The value indicated that the respondents were very ready in teaching when it comes to the different strategies of teaching content.

Further, the findings unconcealed that the respondents obtained an outstanding performance in most indicators of the pedagogical knowledge except on applying range of teaching methods to develop vital and imaginative thinking, and also higher order thinking skills, making use of differentiated, developmentally acceptable learning experiences to handle learners' gender, needs, strength, interests, and experiences; and on designing, selecting, organizing, and employing assessment methods coherent to curriculum needs or requirements. This suggests that the respondents were well-trained on what approaches to use in delivering the instructions and equipped with enough knowledge on how a specific content could be best transferred to specific learners.

This finding was supported by the study of Wang, Utemov, Krivonozhkina, Liu, and Galushkin (2017) [17] justifying high level of pedagogical readiness of mathematics teachers to introduce innovative forms of organization of educational activities.

This implies that the instructors may continue in honing the skills of the learners in applying knowledge of content within and across teaching areas, and in providing effective strategies and other pedagogical skills especially that we are leading into an outcome-based education.

**Table 3** Level of Readiness of BSED-Math Pre-service Teachers in Teaching on Technological Knowledge

| **Indicators** | **Mean Score** | **Description** | **Interpretation** |
|---|---|---|---|
| 1.selects, develops, organize, and uses appropriate teaching and learning resources, including ICT, to address learning goals; | 2.75 | Satisfactory | Moderately Ready |
| 2.shows expertise in handling technological devices and its processes necessary in the discussion; | 2.57 | Unsatisfactory | Less Ready |
| 3.uses technology in communicating with the learners as an extension to discussions. | 2.05 | Unsatisfactory | Less Ready |
| **Grand Mean** | **2.46** | **Unsatisfactory** | **Less Ready** |

As reflected on the table, the respondents were rated as Unsatisfactory with a grand mean of 2.46. This means that the pre-service teachers were less ready in incorporating technology to the classroom instructions. The integration of technology in the lessons was insufficient as observed during the teaching and learning process.

The skills in handling technological devices especially on the process that were necessary for discussion and lack extension of discussion with the use of multi-media, social media, schoology, google classroom and others were not evident.In an informal interview conducted, the students revealed that they were not mindful on the advantages of utilizing the informational websites like weblog, schoology, google classroom, Edmodo, and other webpages that will serve as an extension of the class discussions where the students and the faculty may exchange information, updates, submission of requirements and giving of assignments and other related activities. Moreover, during the

interview, most pre-service teachers were not aware of the many applications available for download that will give teachers a different take on the lesson and a different learning experience for the students.

The findings were similar to the study of Burden and Hopkins (2016) [18] where pre-service teachers are positively disposed to use and teach with mobile devices like the iPad, but faced a number of barriers and challenges which reduced their ability to do so. Moreover, Ertmer et al as cited by Burden and Hopkins (2016) averred that only few can have access to technology like projector, that could enhanced in the teaching and learning through video presentations.

This implies that the faculty may ensure that the students are more aware of the full range of pedagogical affordances available through mobile devices and those that support effective classroom learning methods in classroom environment where not every student has access to a personal device.

**Difference on the level of readiness of the pre-service teachers along the content knowledge, pedagogical knowledge and technological knowledge**

There was a significant difference on the level of readiness of pre-service teachers in teaching along content, pedagogical, and technological knowledge with a p. value of (0.000). This means that the respondents performance vary in terms of their content knowledge, pedagogical knowledge and technological knowledge. Since there was a significant difference on the level of readiness of the pre-service teachers in teaching, a Post Hoc Analysis was conducted using Wilcoxon Signed Rank Test to determine the significant difference between content and pedagogical knowledge, between content and technological knowledge, and between pedagogical knowledge and technological knowledge.

**Table 4** Test of Difference of the Pre-Service Teachers' Readiness in Teaching

| | Mean | SD | FM | p-value | Z-values | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PK – CK | p-value | TK – CK | p-value | TK – PK | p-value |
| CK | 2.6375 | 0.72081 | | | | | | | | |
| PK | 4.4830 | 0.43589 | 30.872 | 0.000 | -3.920 | 0.000 | -0.806 | 0.420 | -3.921 | 0.000 |
| TK | 2.4010 | 0.97134 | | | | | | | | |

There was a significant difference on the level of readiness of the pre-service teachers in teaching between content knowledge and pedagogical knowledge with a p-value of 0.000. This means that pre-service teachers possessed outstanding pedagogical skills in teaching Mathematics but they lack mastery on the basic foundations of the course.

Findings further revealed that there was no significant difference between content knowledge and technological knowledge with the p value of (0.420). This means that the performance of the pre-service teachers do not vary much when it comes to content knowledge and technological knowledge. The respondents performed unsatisfactorily on these knowledge. Moreover, pre-service teachers have inadequate and insufficient strategies, resources, access and orientation on the use of multi-media, advanced technologies, gadgets, and educational websites in which they could use as the extension of their classroom.

Additionally, the findings also revealed that there was a significant difference on the level of readiness between pedagogical knowledge and technological knowledge. This means that the pre-service teachers possessed outstanding pedagogical skills in teaching Mathematics but fell short in integrating digital devices in the lesson.

The findings supported the study of Bingimlas (2018) [19] showing a significant difference between technological content knowledge or information and experience in teaching.. A recommendation ensuing from the study was that teachers or lecturers must modify their teaching strategies into effective learning approaches utilizing technology.

This implies that the instructors of SUCs may provide adequate learning experiences to their students in handling technological devices especially on the process that were necessary for discussion and lack extension of discussion

with the use of multi-media, social media, schoology, google classroom and others. Further, they may provide assistance through review classes and implement peer mentoring in the class to aid in the mastery of the topics in teaching Mathematics.

## 4. CONCLUSION

**Content Knowledge**

The respondents were moderately ready having insufficient knowledge in almost all the topics with the lowest mean in Geometry 1. In university standard, it means that the pre-service teachers were not ready in terms of mathematical content. Respondents showed poor performance in answering these questions. Clearly, there were many difficulties experienced by students in solving mathematical problems.

Teachers may motivate students to learn the essential concepts on these topics especially in Geometry 1, and may inculcate problem solving ability among students' through different techniques, and must address these difficulties so that students will develop geometric skills. Varied and engaging activities may be given to students, and that formulae and problem solving may be learned via applying and experiencing by the students. Moreover, they may provide review classes to students to help recall mathematical concepts which could fortify mastery on solving mathematical problems.

**Pedagogical Knowledge**

The respondents have a very high level of readiness when it comes to the different strategies of teaching content and how these knowledge could be transferred appropriately to the learners. It means that the pre-service teachers were very ready to engage in teaching. They were well-trained on what approaches to use in delivering the lessons; diligent in their job as teaching practitioners displaying dedication in their daily work and showing high respect to their future profession; and they have sufficient knowledge on how a particular content can be best transferred to specific learners.

The instructors of state universities and colleges may continue in honing the skills of the learners in applying knowledge of content within and across teaching areas, and in providing effective strategies and other pedagogical skills especially that they are leading into an outcomes-based education.

**Technological Knowledge**

The integration of technology in the lessons was insufficient as observed during the teaching and learning process. They lack skills in handling technological devices especially on the process that were necessary for discussion and lack extension of discussion with the use of multi-media, social media, schoology, google classroom and others. The pre-service teachers were less ready on integrating technology to the classroom instructions.

The faculty may ensure that the students are more aware of the full range of pedagogical affordances available through mobile devices and those that support effective classroom learning strategies in settings where not every student has access to a personal device.

**Test of Difference of the Pre-Service Teachers' Readiness in Teaching**

The pre-service teachers' performance varies in terms of their pedagogical knowledge and content knowledge. Pre-service teachers possessed outstanding pedagogical skills in teaching Mathematics but they lack mastery on the basic foundations of the course. Moreover, pre-service teachers were not mindful enough of the strategies, resources, access and orientation on the use of multi-media, advanced technologies, gadgets, and educational websites in which they could use as the extension of their classroom. On the other hand, the performance of the pre-service teachers did not vary much when it comes to content knowledge and technological knowledge. The respondents performed unsatisfactorily on these knowledge.

The instructors of SUCs may provide adequate learning experiences to their students in handling technological devices especially on the process that are necessary for discussion and use this technologies as an extension to discussion using multi-media, social media, schoology, google classroom and others. Further, they may provide review classes to students to help recall mathematical concepts which could fortify mastery on solving mathematical problems.

A seminar or training- workshop could be done to address the pre-service teachers' insufficient knowledge on the integration of ICT in classroom instructions.

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