MJSIR
Mountain Journal of Science and Interdisciplinary Research
ISSN 2619-7855
June 2018 • 78 (1) : 32-48

Math Teaching Readiness of Secondary Mathematics Pre-Service Teachers in the Cordillera Administrative Region

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ABSTRACT

This study investigated the readiness of Secondary Mathematics Pre-service Teachers (SMPTs) in teaching mathematics. This was done by triangulating their academic performance, student-teaching performance, and perceived readiness in teaching mathematics. The study was conducted with 89 SMPTs who recently completed their mathematics teaching degree requirements from seven Teacher Education Institutions in the Cordillera Administrative Region. Results showed that academically, the SMPTs excelled in their ICT-related subjects followed by their Education and other basic subjects, while lowest grades were obtained in the advanced and basic math subject categories. In terms of their student-teaching performance, the SMPTs obtained the highest ratings for teacher's personality followed by communication skills and student-teacher relationship, whereas lowest ratings were in the areas of questioning skills, lesson integration, and teaching method. Moreover, the SMPTs perceived the highest level of readiness for learning environment and pedagogical knowledge, while they scored lowest for community linkages and content knowledge components of the National Competency-Based Teacher Standards (NCBTS) and Technological Pedagogical and Content Knowledge (TPACK) constructs, respectively. The study shows the lack of readiness of the SMPTs in teaching mathematics based from the national frameworks of math teacher education and basic education in the country.

KEYWORDS

Teaching readiness
Pre-service teachers
Math education
Career choice

INTRODUCTION

The ultimate goal of any Teacher Education Institution (TEI) is to fully develop and equip its pre-service teachers with the necessary teaching skills and competencies in preparation for their future teaching job. In the international landscape, studies investigated the sufficiency of the preparation of pre-service teachers (Ingvarson, 2007; Memnun

& Hart, 2014; & Niess, 2013); the potential of pre-service teachers in applying their acquired knowledge into their actual teaching (Cavanagh & Garvey, 2012; Cheng, 2011; Sanchez, 2011; Tondeur, J., Braak, J., Sang, G., Voogt, J., Fisser, P., & Ottenbreit-Leftwich, A. (2012); the preparations of mathematics pre-service teachers in handling mathematics subjects and in integration of technologies (Matthews, M., Rech, J., & Grandgenett, N. (2010); Norton, 2012; Ozgen & Alkan, 2014; Rosas & West, 2011; and Ruggiero & Mong, 2013).

In the Philippines, the preparation of pre-service teachers through Education degree programs such as Bachelor of Elementary Education (BEEd); and Bachelor of Secondary Education (BSEd) is a responsibility of Higher Education Institutions (HEIs) (Section 1, Article I, CHED Memorandum Order (CMO 30 series of 2004). Specifically, the BSEd program aims to develop high school teachers who can teach in one of different learning areas in high school like Mathematics, Physical Sciences, Biological Sciences, English, Filipino, among others (Section 4, Article III). BSEd consists of general education courses (63 units) which cover foundation general education knowledge and skills; professional education courses (51 units) which include theoretical knowledge about teaching and learning, methodological skills, experiential knowledge and skills. It also includes professional and ethical values and specialization courses (60 units) which have subject matter knowledge appropriate to the level of teaching high school students (Sec. 7-8, Art. 5, CMO 30 s. 2004). The content knowledge of the mathematics pre-service teachers is catered by both general education and specialization courses. Their pedagogical knowledge is supplied by the professional education courses. They are required to take information technology-related courses as part of their general education courses and at least 6 units of educational technology courses as part of their professional education course requirements needed for their technological knowledge.

Further, as the supervising executive branch of the Philippine government, the Commission on Higher Education (CHED) sets competency standards for the content and pedagogical knowledge that a BEEd or BSEd graduate must have. For instance, a BEEd/BSEd graduate must have a meaningful and comprehensive knowledge of the subject matter that he/she will teach. Moreover, to ensure the quality of pre-service teacher graduates in the country, the national government through the Department of Education (DepEd), implemented a Teacher Education and Development Program (TEDP) that is able to conceptualize a teacher's career path as a continuum that starts with entry to a teacher education program until he/she reaches retirement from formal service (CMO No. 30 series of 2007, Annex A). Competency standards expected from graduates of BEEd or BSEd programs in the country were also set (Section 6, Article IV, CMO No. 30, series of 2004). In line with these provisions, the National Competency-Based Teacher Standards (NCBTS) known as Professional Development Guide for Filipino Teachers, was developed through the TEDP in 2006. The NCBTS consists of seven domains incorporating a series of strands of desired teaching performance statements which can be identified as performance indicators of the quality of a teacher's performance (CMO No. 30 series of 2007, Annex A).

In the field of mathematics education in the country, the Department of Science and Technology – Science Education Institute (DOST-SEI), together with the Philippine Council of Mathematics Teacher Education (MATHTED) Inc., authored the Framework for Philippine Mathematics Teacher Education (FPMTE) and the Mathematics Framework for Philippine Basic Education (MFPBE) in 2011 which provides context and direction for the preparation of math teachers and math teaching in the basic education, respectively. In the FPMTE, mathematical content knowledge is considered as the core of knowledge and skills component of math teaching towards achieving excellence. This is supported by mathematical pedagogical knowledge, mathematical disposition and professional development, and general pedagogy and management skills. Likewise, the MFPBE indicates that critical and analytical thinking are the main goals of the Philippine Math education.

There, however, seems to be problems in the preparation of pre-service teachers in the country. For instance, the performance of teacher education graduates in their board examination has been consistently low. In fact, the seven Licensure Examination for Teachers (LET) results in the last four years (2012-2015) reported a mean of 34.59% national passing rate and the result in March 2015 had a passing rate of 31.63%. This implies that only around one-third of the secondary teacher education graduates pass their licensure examination. Moreover, with the goal of improving the quality of education in the country, the DepEd implemented the K to 12 Curriculum for basic education through Republic Act No. 10533, or the Enhanced Basic Education Act of 2013. Through the K to 12 program, the DepEd believes that they are raising the bar for quality assurance of Filipino basic education graduates coupled with the challenge of coming up with effective delivery of content, instruction, and assessment among basic education teachers. In the K to 12 Curriculum, previous basic college mathematics subjects such as College Algebra and Trigonometry are now taken during the senior high school years, which may require more content preparation for high school mathematics teachers.

In addition, Limjap (2009) et al. found out that some of the TEIs in the National Capital Region (NCR) were not ready to implement the New Teacher Education Curriculum (NTEC) because of the lack of available course outlines and references for the new subjects prescribed in the NTEC. This is aside from insufficient training of math teachers to handle these new subjects and syllabi which are not well articulated. From their findings, they recommended actions to address such apparent problems on the readiness of the TEIs in implementing the NTEC like providing venues for math teachers to discuss and share resources to address content, pedagogical, and methodological issues in the implementation of the NTEC.

Likewise, Julianes (2008) argued that TEIs in the country do not attract the best or the highly intellectually capable high school graduates because TEIs are generally the most accessible colleges, and the least expensive to go to. He also pointed out that there are invariably few science/ math major enrollees which makes the science/ math teacher education courses not financially viable for the colleges to offer. As a result, science/math majors are combined with other students who are not in science/math education. This lessens the rigidity in the preparation of future science/math teachers. Moreover, he argued that most teacher education colleges do not have adequate number of teacher educators who are themselves specialists in science/mathematics since the graduate degrees of teacher educators are usually in Educational Administration, Counseling, or Curriculum but not in Science/Math.

These situations in the education arena have led to the following queries: Are the Teacher Education Institutions (TEIs) preparing the pre-service teachers towards the set teacher competency standards and math education frameworks in the country? With the relatively low passing rates in licensure examinations, how ready are the pre-service teachers in the actual world of basic education teaching, most especially in their major field of specialization? Are the incoming mathematics teachers prepared for the challenges of the new K to 12 Curriculum? Are they equipped with enough knowledge and skills in order to achieve the critical and analytical thinking core goals of Philippine math education?

With the present situation of mathematics education in the country covering issues such as low passing rate of pre-service teachers in their licensure examinations, the demands of mathematics teaching in the basic education and the challenges brought about by the implementation of the new K to 12 Curriculum have to be addressed. The study aimed to explore the math teaching readiness of SMPTs relative to the existing competency standards and frameworks of math teacher preparations and math teaching in the country's basic education. Specifically, it aimed to determine the SMPTs' academic and student-teaching performance, the perceived readiness of the teacher in teaching mathematics, and the relationships of these readiness indicators.

THEORETICAL FRAMEWORK

The study was anchored on the National Competency-Based Teacher Standards (NCBTS) framework in Annex A of the CHED Memorandum No. 52, series of 2007; the Framework for Philippine Mathematics Teacher Education (FPMTE); and the Mathematics Framework for Philippine Basic Education (MFPBE) by the Department of Science and Technology – Science Education Institute (DOST-SEI) and the Philippine Council of Mathematics Teacher Education (MATHTED), Inc.

The NCBTS (2006) Framework was based on the provisions of the CMO No. 30, series of 2004, also known as the Revised Policies and Standards for

Undergraduate Teacher Education Curriculum in the country. This was established under the Teacher Education and Development Program (TEDP) of the DepEd, based on the core values of Filipino teachers and on the principles of effective teaching and learning. As shown in Figure 1, the NCBTS consists of seven domains incorporating a series of strands of desired teaching performance statements which can be identified as observable performance indicators of the quality of a teacher's performance. The middle domains 2, 3, 4, 5, and 6 represent standards refer to "The Teacher as Facilitator of Learning," whereas the two outer domains 1 and 7 represent standards referring to "The Teacher as Learner." The middle domains can further be divided into two sub-categories. The innermost domains 3, 4, and 5 represent the specific teacher practices related to the technical aspects of the teaching-learning processes, whereas domains 2 and 6 represent the specific teacher practices that embed the learning process in appropriate contexts. Moreover, domains 3, 4 and 5 refer to what may be called good teaching strategies and are very closely related to each other. The diagram also shows that Curriculum is at the heart of the framework.

The study was also based on the Technological Pedagogical and Content Knowledge (TPACK) Framework by Mishra and Koehler (2006) (Figure 2). Shulman (1986) first introduced the framework of Pedagogical Content Knowledge (PCK) referred to as a teaching knowledge which blends both Content Knowledge (CK) and Pedagogical Knowledge (PK). With the rapid emergence of educational technology; however, Mishra and Koehler (2006), proposed the TPACK framework which extends the PCK framework by integrating technology knowledge (TK) for teaching (Abbitt, 2011; Schmidt et al., 2009; Zelkowski, J., Gleason, J., Cox, D. C., & Bismarck, S. 2013). Figure 2 shows the seven domains of the TPACK framework (Mishra & Koehler, 2006). These are: Pedagogical Knowledge (PK) described as the Knowledge of nature of teaching and learning, including teaching methods, classroom management, instructional planning, assessment of student learning, etc. The next is Content Knowledge (CK) described as the knowledge of the subject matter to be taught (e.g., earth science, mathematics, language arts, etc.) followed by Technology Knowledge (TK) characterized continually changing and evolving knowledge base that includes knowledge of technology for information processing, communication, and problem solving. It focuses on the productive applications of technology in both work and daily life. Pedagogical Content Knowledge (PCK) is knowledge of the pedagogies, teaching practices, and planning processes that are applicable and appropriate to teaching a given subject matter. Also included is Technological Content Knowledge

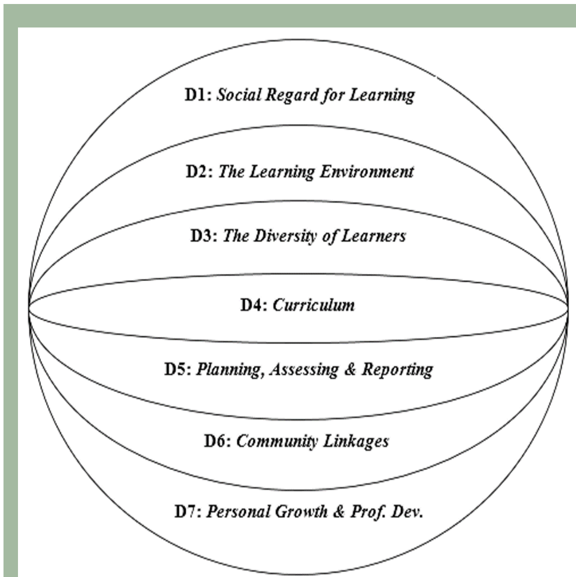

Figure 1. The National Competency-Based Teacher Standards (NCBTS) Framework

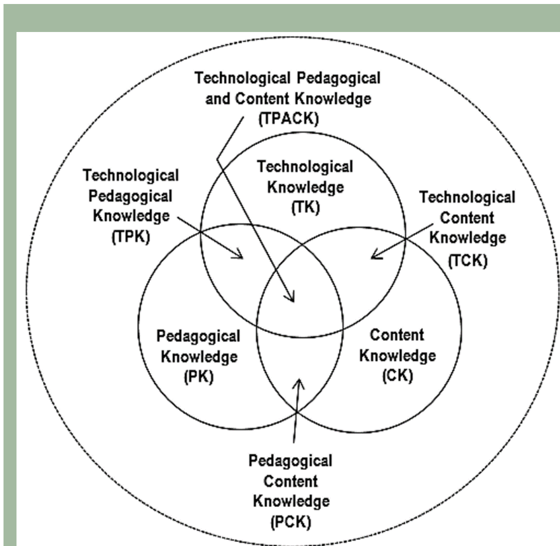

Figure 2. The Technological Pedagogical Content Knowledge (TPACK) Framework (Mishra & Koehler, 2006)

(TCK) as the knowledge of the relationship between subject matter and technology, including knowledge of technology that is used in exploring a given content discipline, followed by Technological Pedagogical Knowledge (TPK) described as the knowledge of the influence of technology on teaching and learning as well as the affordances and constraints of technology with regard to pedagogical designs and strategies and Technological Pedagogical Content Knowledge (TPACK) as the knowledge of the complex interaction among the principle knowledge domains (content, pedagogy, technology).

Moreover, the Framework for Philippine Mathematics Teacher Education (FPMTE) and the Mathematics Framework for Philippine Basic Education (MFPBE) authored by the Department of Science and Technology – Science Education Institute (DOST-SEI) and the Philippine Council of Mathematics Teacher Education (MATHTED), Inc. contextualized the preparation of mathematics teachers and math teaching in the basic education, respectively, in the country. The FPMTE emphasizes that mathematical content knowledge is the core component for a fully competent math teacher. This refers to the math teacher's knowledge and understanding of and competencies in the contents of mathematics.

On the other hand, the MFPBE has pointed out that critical and analytical thinking are the core goals of math teaching in the country for the development of a mathematically empowered citizenry. In addition, the MFPBE indicates that the Philippine math education program at the elementary and secondary levels aims to teach the most fundamental and useful contents of mathematics, which include geometry, patterns, functions, and algebra — number and number sense, measurement, and data analysis and probability. These have been eventually called the five strands of mathematics in the K to 12 Curriculum in the country. Along with the mathematical content, the MFPBE also identified six cognitive demands necessary but not sufficient to accomplish the goals of the Philippine school math education for all students. This includes visualizing, knowing, computing, solving, applying, and proving.

In general, it is hoped that the study would provide insights for possible improvements in the preparations provided by the different TEIs to the SMPTs, taking into account the implementation of the new K to 12 curriculum in the country.

Also, the result hopes to help explain and suggest possible solutions to the apparent problems in mathematics education in the country. The results of the study could likewise serve as an assessment of the current curriculum in preparing pre-service teachers based on the set national standards in math education such as teaching mathematics with the integration of technology, which is one of the 21st century skills. The study may shed light on how to maximize the preparations of the SMPTs and strengthen their commitment to teaching, provide ideas on how their student-teaching experiences contribute to their readiness in teaching mathematics for possible improvement, and offer insights for the TEIs in providing career guidance to students who are entering the mathematics teaching career. For the pre-service teachers, the study may help them realize their readiness in teaching mathematics and the necessary skills to cope with the challenges of being a mathematics teacher.

The readiness of the SMPTs in teaching mathematics was investigated by triangulation of their academic performance; their student-teaching performance; and their perceived readiness in teaching mathematics with reference to the TPACK, NCBTS, FPMTE, and MFPBE Frameworks. Particularly, these four frameworks were used as baselines in assessing the readiness of the SMPTs in teaching mathematics using the three identified areas of readiness indicators.

METHODOLOGY

The study was descriptive in nature and utilized quantitative data to describe the mathematics teaching readiness of the SMPTs in terms of their academic performance, student-teaching experiences, and their perceived readiness in teaching mathematics. A validated research instrument was used to explore the perceived readiness in teaching mathematics while academic performance was based on their college grades. Their actual student-teaching ratings provided the data for their student-teaching performance.

Instrumentation

The study used the National Competency-Based Teacher Standard Assessment Instrument (NCBTSAI) and the Technological, Pedagogical and Content Knowledge Assessment Instrument (TPACKAI) in exploring the perceived readiness of the SMPTs in teaching mathematics. The NCBTSAI is a 72-item questionnaire which was based on the performance indicators of each of the seven domains of the NCBTS as stipulated in the Annex A of the CMO 52, series of 2007, also known as Addendum to CMO 30, Series of 2004. This was used to determine the general perceived readiness of the SMPTs in teaching mathematics in accordance with the national standards. On the other hand, the TPACKAI is a 74-item questionnaire which was mainly adapted from the Technological, Pedagogical and Content Knowledge (TPACK) instrument developed by Zelkowski et al. (2013). This was used to explore the perceived preparedness of the SMPTs in terms of their knowledge on technology, pedagogy, and mathematics content. The TPACKAI was validated by reestablishing its reliability in the context of the present study with a relatively high Cronbach's alpha average of 0.797 among the seven components and a fairly high overall reliability as indicated by a Cronbach's alpha value of 0.95.

Participants

The participants of the study were graduating SMPTs from seven participating TEIs in four provinces of the Cordillera Administrative Region. Initially, the researcher considered ten known TEIs to participate in the study; however, three private TEIs did not meet the criterion of having a minimum number of five graduating Bachelor in Secondary Education (BSEd) students in order to be included as a participating TEI. The researcher considered all the 95 graduating BSEd students from the seven TEIs as participants but only 89 of them completed the documents needed in the study. Of the 89, 30 are males and 59 are females; 67 come from public TEIs while 22 come from private TEIs. Their ages ranged from 18 to 27. The data collection was done from March to June 2015 with the informed consent of the participants. The researcher also assured the confidentiality of the identity of the participants and the participating TEIs.

Data from the study were collected during the time when the participants finished all of their academic and non-academic requirements in the BSEd major in Mathematics degree, including their student-teaching requirements. The data were collected when the participants were at the peak of their mathematics teaching preparation.

Data analysis

The study utilized both descriptive and inferential statistics in the data analysis. Particularly, the study used weighted means and ranks to describe the level of academic and student-teaching performances as well as the perceived readiness of the participants. Stepwise Regression Analysis was employed to explore the potential interrelationships of the readiness indicators included in the study.

Moreover, to set a common range of the measurement of academic and student-teaching performances of the respondents who were under different teachers/professors, their academic grades and student-teaching ratings were transmuted into descriptive form using the common descriptive equivalent being used in the different participating TEIs. Also, for a more particular analysis, the academic grade of the respondents were grouped according to the similarity of subjects which resulted to seven subject categories. Likewise, their student-teaching ratings were grouped according to the different areas of the teaching-learning process which resulted to 12 categories. These categories became the basis for computing the weighted average grade and student-teaching performance of the participants.

RESULTS AND DISCUSSION

Academic Performance of the SMPTs

In this study, the academic performance of the SMPTs is considered as one of the indicators of mathematics teaching readiness. This was investigated using the participants' academic grades in college. To ensure that the possible differences of the academic grades are not due to differences in school, the overall grade average was compared to the different schools by using ANOVA. It was found that there was no significant difference at 0.05 level.

Table 1. *Academic performance of the respondents (N=89)*

a. Academic performance of the SMPTs in each of the subject components

Subject Component	Ave. unit	Weighted Mean	Std. Dev.	Desc. Eq.	Rank
Basic math subjects (BMS)	16.54	2.04	0.31	G	6
Advanced math subjects (AdMS)	29.71	2.12	0.31	G	7
Applied math subjects (ApMS)	14.61	1.92	0.29	G	4
Education subjects (EducS)	39.70	1.80	0.26	VG	2
ICT-related subjects (IRS)	13.70	1.71	0.28	VG	1
English subjects (EngS)	15.87	1.97	0.29	G	5
Other basic subjects (OBS)	57.75	1.89	0.23	G	3
Overall	196.29	1.93	0.22	G	

Legend:

Range	*Descriptive Equivalent*
1.00 – 1.12	Excellent (E) or A^+
1.13 – 1.37	Very Outstanding (VO) or A
1.38 – 1.62	Outstanding (O) or A^-
1.63 – 1.87	Very Good (VG) or B^+
1.88 – 2.12	Good (G) or B
2.13 – 2.37	Very Satisfactory (VS) or B^-
2.38 – 2.62	Satisfactory (S) or C^+
2.63 – 2.87	Fair (F) or C
2.88 – 3.00	Passing (P) or C^-

b. Analysis of variance

	Sum of Squares	df	Mean Square	F	p-value
Between Groups	10.392	6	1.732	21.898**	0.000
Within Groups	48.722	616	0.079		
Total	59.115	622			

$^{**}p<0.01$

Table 1(a) reveals that the SMPTs perform best in their academics in the ICT-related subjects (IRS) and Education subjects (EducS) subject components with a "very good" descriptive equivalent. Their lowest academic performances, on the other hand, were observed in the Advenced nath subjects (AdMS), Basic math subjects (BMS) and English subjects (EngS) subject components with a 'good' descriptive equivalent.

Examples of the IRS are Educational Technology, Fundamentals of Computers, and Introduction to Information Technology. The EducS includes Principles of Teaching, Facilitating Learning, Child and Adolescent Development, and Assessment of Learning while the OBS includes all the other general education subjects such as Science, Filipino, Social Science, Physical Education, and National Service Training Program subjects. The AdMS category consists of Abstract and Advanced Algebra, Advanced Statistics, Linear and Modern Algebra, Analytic Geometry, Calculus, and Number Theory subjects while the BMS include College/ Elementary Algebra, Basic Probability and Statistics and Trigonometry. The EngS component includes Communication Arts, Written and Oral Communication, and Effective Speech.

As shown in Table 1(b), ANOVA result indicates a significantly ($p<0.05$) different academic performance of the SMPTs in the identified subject components.

Results showing that the SMPTs perform best in their ICT-related subjects may not be surprising because the participants belong to the digital generation. They have easy access to different information and communication technologies. However, the low academic performance of the SMPTs in their Mathematics subjects may imply that their major field of specialization appears to be more difficult than their other subjects. This is alarming considering that they will be teaching Mathematics subjects as their major field of specialization. Other than the basic college math subjects, the advanced math subjects are supposed to deepen their knowledge in the fundamental Mathematics subjects that they will be teaching in the secondary level. However, this appears to be their lowest grades.

Also, as future math teachers, the "good" descriptive equivalent of their academic grades in their Mathematics subjects may not be enough as they might need to be at least "very good" in their field of specialization. The result also reveals that their grades in the Basic and Advanced Math subjects have the highest standard deviation (0.31) which implies that some of the SMPTs may have satisfactory or even fair grades in their major subjects.

Relative to the Philippine math education context and standard, the results may imply a relatively insufficient readiness of the SMPTs in their content preparations in teaching Mathematics. This is because the FPMTE identified mathematical content knowledge as the core of knowledge and skills component towards achieving excellence in math teaching in the country. It should likewise be noted that in the NCBTS Curriculum, which includes mastery of the subject matter, the teacher should have a mastery of the subject matter so that his/her students will understand and appreciate the importance of the lessons. Based on the FPMTE and NCBTS, the SMPTs are expected to excel in their major fields of specialization in order to achieve excellence in mathematics teaching. Likewise, the result may raise concerns on how the SMPTs will achieve the critical and analytical thinking central goals of math teaching in the basic education as specified in the MFPBE. This is because the SMPTs themselves appear to have encountered difficulties in their mathematics subjects.

Further, the seeming difficulties encountered by SMPTs in their mathematics subjects may be passed to their future students, most especially during their first years of teaching. This may have subsequent negative effects on the cycle of math education, considering that knowledge in the fundamentals of mathematics is essential in understanding concepts in the advanced mathematics. Thus, if the apparent issue on content preparedness of the SMPTs will not be addressed, it might be carried from one stage to another in the math education cycle.

This is supported by Norton (2012) in his findings that the level of high school mathematics undertaken was highly correlated with success in the teacher education unit design to prepare prospective mathematics teachers.

In addition, this alarming result may explain, in some ways, the apparent low performance of secondary pre-service teachers in the Licensure Examination for Teachers (LET) as well as the appearing poor math education in the country. Hence, to prevent these problems in math education, the concerned TEIs may need to revisit their preparation programs for math teachers. Those SMPTs who have graduated may need to undergo further trainings, most especially in those that focus on the math content knowledge, before deploying them to actual math teaching jobs.

Student-Teaching Performance of the SMPTs

The student-teaching performance of the participants was explored using actual classroom teaching ratings given by the cooperating and supervising teachers. Table 2(a) shows that the SMPTs had a very good performance in all of the identified teaching components during their student teaching sessions. However, the ANOVA test result in Table 2(b) indicates that at 0.05 level, they have significantly different ratings in the different components. The highest score was obtained in the teacher's personality component, followed by communication skills, student-teacher relationship, lesson planning, classroom/time management, and instructional materials components. These six components with ranks ranging from second to the seventh are not significantly different based on the LSD post hoc test of the ANOVA. The lowest ratings were obtained in the areas of questioning skills, lesson integration, and teaching method,

Table 2. *Student-teaching performance of the respondents*

a. student teaching performance of the respondents in each of the teaching components

Teaching Component	Ave. unit	Weighted Mean	Std. Dev.	Desc. Eq.	Rank
Teacher's personality (TP)	73	4.49	0.34	VG	1
Communication skills (CS)	73	4.20	0.48	VG	2
Questioning skills (QS)	68	3.74	0.50	VG	12
Lesson planning (LP)	66	4.16	0.53	VG	4
Content knowledge(CK)	73	4.06	0.42	VG	7
Lesson integration (LI)	73	3.79	0.51	VG	11
Teaching method (TM)	73	3.87	0.43	VG	10
Instructional materials (IM)	73	4.13	0.47	VG	5
Assessment/assignments (AA)	60	3.96	0.44	VG	8
Classroom/time management (CTM)	72	4.12	0.43	VG	6
Motivation (M)	50	3.91	0.45	VG	9
Student-teacher relationship (STR)	50	4.17	0.38	VG	3
Overall	73	4.06	0.37	VG	

Legend:

Range	*Descriptive Equivalent*
4.50 – 5.00	*Excellent (E)*
3.50 – 4.49	*Very Good (VG)*
2.50 – 3.49	*Good (G)*
1.5 – 2.49	*Fair (F)*
1 – 1.49	*Poor (P)*

b. Analysis of variance

	Sum of Squares	df	Mean Square	F	p-value
Between Groups	133.658	11	3.060	14.876**	0.000
Within Groups	162.902	796	0.206		
Total	196.560	803			

***p<0.01*

which are not significantly different from each other based on the same post hoc test result. Sample items for the teacher's personality component are 'Teacher is neat and well-groomed', 'The teacher is free from mannerisms that distract learners' attention', and 'The teacher possesses a personality that commands respect and attention'. For the questioning skills component, sample items were 'The teacher's questioning skill stimulates discussion in different ways such as probing for learner's understanding', 'The teacher's questioning skill was shown in his/her way of helping learners articulate their ideas', and 'The teacher's questioning skill was shown in his/her way of stimulating curiosity'.

Although they have a 'very good' rating in all of the teaching components, numerically, the result may indicate that the SMPTs have 'strength in their teacher's personality' as the highest rated component. However, they may have encountered difficulties in the areas of questioning skills, lesson integration and teaching method as these had lowest rated components. Thus, the result may imply lack of readiness of the SMPTs in the context of mathematics teaching in basic education as stipulated in the MFPBE. This is because the MFPBE indicates that critical and analytical thinking are the core goals of Philippine basic math education but questioning skills, lesson integration, and teaching method, which are essential components in developing critical and analytical thinking skills, are the lowest rated areas.

Another notable result is that the teaching method of the SMPTs is one of the lowest rated components during their student-teaching. This, despite the fact that they had the second highest academic performance in their education subjects. This shows that the SMPTs may have understood their pedagogy subjects in their education subjects but they were not able to apply them in their actual classroom teaching. This parallels the findings of Cheng (2011) where the core dilemma in initial teacher education was bridging the gap between theory and practice. This can likewise be validated by the findings of Tondeur et al. (2011) indicating that aligning theory and practice was the primary theme among the seven themes they discovered related to the preparation of pre-service teachers. In addition, the result indicating that teaching method is among the lowest rated components is similar to the findings of Ozgen and Alkan (2014) that although more than half of their graduating secondary mathematics pre-service teacher respondents could develop classroom activities in their mathematics teaching, some of them still lack the skill for developing classroom activities.

Lastly, the result of the present study somehow reiterates the reported lowest academic performance of the SMPTs in their mathematics subjects compared to the non-mathematics subjects. In fact, the content knowledge component did not emerge as one of the highly rated areas in their student-teaching performance since this ranked seventh out of the 12 components.

Perceived Readiness of the SMPTs in Teaching Mathematics

Table 3(a) shows that except for the community linkages with an "agree" descriptive equivalent, the SMPTs "strongly agree" that they can comply with each of the NCBTS components as future math

Table 3. *Perceived readiness of the respondents in teaching mathematics under the NCBTS constructs (N=67)*

a. Mean of each of the NCBTS components

NCBTS Component	Mean	Std. Dev.	Desc. Eq.
Social regard for learning (SRL)	3.65	0.39	SA
Learning environment (LE)	3.67	0.31	SA
Diversity of learners (DL)	3.56	0.38	SA
Curriculum (Cur)	3.59	0.35	SA
Planning, assessing & reporting (PAR)	3.56	0.35	SA
Community linkages (CL)	3.45	0.38	A
Personal growth & professional development (PGPD)	3.60	0.38	SA
Overall	3.59	0.33	SA

Note:

Range	*Descriptive Equivalent (DE)*
3.50 – 4	*Strongly Agree (SA)*
2.50 – 3.49	*Agree (A)*
1.50 – 2.49	*Disagree (D)*
1 – 1.49	*Strongly Disagree (SD)*

b. Analysis of variance

	Sum of Squares	df	Mean Square	F	p-value
Between Groups	2.218	6	0.370	2.809*	0.011
Within Groups	60.788	462	0.132		
Total	63.006	468			

$^{**}p<0.05$

teachers. Specifically, they have the highest ratings in the components of learning environment, social regard for learning, and personal growth and development. Moreover, Table 3(b) indicates a significant ($p<0.05$) ANOVA result which implies that the SMPTs perceived different levels of confidence in the different domains of the NCBTS. Particularly, the LSD post hoc test result of the ANOVA indicated that the community linkages component appears to be significantly lower than the other NCBTS components at 0.05 level. This may be credited to the abstract characteristics of mathematics where the SMPTs may not know how to connect the different math topics to real-life situations in the community.

Furthermore, this outcome could be another offshoot of the apparent difficulty encountered by the SMPTs in their mathematics subjects as indicated by their lower grades in the math subjects compared to the non-math subjects. It is because a clear grasp of the concept of a certain topic may be needed in order to have a high level of confidence in connecting the topic to real life situations. Likewise, the result could be justified by their apparently lowest student-teaching ratings in the area of lesson integration where their ability to relate their lessons to real-life situations was assessed.

In terms of perceived knowledge preparedness, Table 4(a) shows that the SMPTs "agree" that they possess the knowledge technology, pedagogy, and content in teaching Mathematics. It also indicates that they perceive themselves to be more competent pedagogical knowledge and less proficient with content knowledge. However, the ANOVA result in Table 4(b) reveals that the differences are not significant at 0.05 level. This shows the SMPTs perceived similar level of knowledge preparedness in the different TPACK components. Nevertheless, the highest score in the pedagogical knowledge is consistent with their academic performance where they excelled in their education subjects. Likewise, their lowest perceived readiness in their content knowledge is consistent with their lowest academic performance in their Mathematics subjects.

Table 4. *Perceived readiness of the respondents in teaching mathematics under the TPACK constructs (N=75)*

a. Mean of each of the TPACK components

NCBTS Component	Mean	Std. Dev.	Desc. Eq.
Technological knowledge (TK)	3.03	0.40	A
Content knowledge (CK)	2.99	0.45	A
Pedagogical knowledge (PK)	3.14	0.39	A
Pedagogical content knowledge (PCK)	3.01	0.42	A
Technological content knowledge (TCK)	3.06	0.36	A
Technological pedagogical knowledge (TPK)	3.12	0.35	A
Technological pedagogical and content knowledge (TPCK)	3.04	0.36	A
Overall	3.06	0.35	A

Legend:

Range	Descriptive Equivalent (DE)
3.50 – 4	*Strongly Agree (SA)*
2.50 – 3.49	*Agree (A)*
1.50 – 2.49	*Disagree (D)*
1 – 1.49	*Strongly Disagree (SD)*

b. Analysis of variance

	Sum of Squares	df	Mean Square	F	p-value
Between Groups	1.482	6	0.247	1.603	0.144
Within Groups	79.802	518	0.154		
Total	81.284	524			

The generally higher scores in the NCBTS compared to the TPACK components may imply a more generalized readiness of the SMPTs to teach math compared to the specific areas of math teaching such as technological, pedagogical and content knowledge. Also, despite the ANOVA result which registered no significance, the lowest score on content knowledge in the TPACK constructs substantiate the insufficient readiness of the SMPTs in teaching Mathematics. This is again considering that content knowledge is identified in the MFPBE as the most important knowledge and skills needed for excellent Mathematics teaching in the country.

Relationships of the Readiness Indicators

Table 5 shows the relationships of the three indicators of math teaching readiness of the SMPTs. It indicates that the Stepwise Regression Analyses included only three of the seven subject components as significantly influential to the corresponding student-teaching performance and perceived readiness of the SMPTs. Only one component of their student-teaching performances appears to be influential in their perceived math teaching readiness. It should be noted that the Stepwise Regression Analyses only include the independent variables with significant results.

In addition, the 'R' and 'R Square' columns specify the correlation coefficient and the variations of the dependent variables, respectively, explained by the independent variable in the analysis. Table 5(a) indicates that the correlation coefficient and variation of the student-teaching performance of the SMPTs explained by their academic performance range from 0.247–0.302 and 6.1%–9.1%, respectively. On the other hand, Table 5(b) shows that the included subject components have correlation coefficients ranging from 0.282 to 0.551 with the corresponding perceived readiness components. Also, this can explain 7.9% to 16.9% of the variations of the indicated perceived readiness components. Lastly, Table 5(c) indicates that only the student-teaching performance of the SMPTs in the communication skills component had significant positive impact (R = 0.264) to their math teaching confidence in the area of social regard for learning. This can explain 7% of the variations of their perceived readiness in this area. It can be noted that the unexplained portion may be attributed to other factors not included in the study that may have affected their student-teaching performance and math teaching confidence, respectively.

The last column in Tables 5(a) and 5(b) shows the regression models. The summary of the relationships of the three mathematics teaching readiness indicators is presented in Figure 3. The ApMS component positively influences the communication skills teaching component by 0.302 per ApMS unit. This means that a one unit increase in the grade of the SMPTs in the ApMS component yields a 0.302 increase in their rating under the communication skills teaching component. It has similar implications in their grades in AdMS and EducS with their student-teaching ratings in the teaching method and instructional materials components, respectively.

It is noted that the numerical and grade descriptive equivalents are inversely related. As a result, a negative model coefficient entails a positive influence, while a positive coefficient denotes a negative influence of the academic performance's subject components to their ratings in the corresponding teaching component.

Plausible explanations for these results are based on the differences of the academic performance of the SMPTs in the different subject components. It is possible that those with high academic performance in the ApMS may have a profound understanding of the applications of mathematics. They may have a clear grasp of the language of mathematics needed to be able to communicate the concepts of Math subject during their student-teaching. Similarly, the AdMS is intended to deepen the knowledge of the SMPTs in basic education mathematics. Consequently, a high grade in this component may imply a clear grasp of the topics. It can be conceived that a teacher who masters his/her lessons is likewise able to discern how to effectively teach such lessons. In addition, the SMPTs learned the different teaching strategies and effective instructional materials in their EducS. Thus, it is expected that having a good grade in the EducS leads to high ratings in the use of instructional materials. In general, the study asserts that the SMPTs need to have high academic performance in the Applied Math subjects, Advanced Math, and Education subject components for a better performance in their student teaching.

The academic performance of the SMPTs in the AdMS positively influenced their perceived

Table 5. *The relationships of the three indicators of math teaching readiness of the SMPTs*

a. The student-teaching performance of the SMPTs in relation to their academic performance

Teaching Component	R	R Square	F-value	Regression model & Coefficient significance
Communication skills	0.302	0.091	7.109**	5.141 – 0.302ApMS**
Teaching method	0.247	0.061	4.614*	4.599 – 0.247AdMS*
Instructional materials	0.258	0.067	5.070*	4.984 – 0.258EducS*

b. The perceived mathematics teaching readiness of the SMPTs in relation to their academic performance

Perceived Readiness	R	R Square	F-value	Regression model & Coefficient significance
NCBTS Component (N=67)				
Learning environment	0.326	0.106	7.741**	4.361 – 0.326AdMS**
Diversity of learners	0.305	0.093	6.688*	4.348 – 0.305AdMS*
Curriculum	0.344	0.118	8.730**	4.405 – 0.344AdMS**
Planning, assessing & reporting	0.306	0.093	6.703*	4.279 – 0.306AdMS*
Personal growth & prof. development	0.282	0.079	5.614*	4.315 – 0.282AdMS**
Overall	0.321	0.103	7.469**	4.298 – 0.321AdMS**
TPACK Components (N=75)				
Content knowledge	0.282	0.079	6.296*	3.841 – 0.282AdMS*
Pedagogical knowledge	0.411	0.169	7.330**	3.040 + 0.551IRS** – 0.469EngS**
Technological pedagogical knowledge	0.359	0.129	5.329**	2.938 + 0.491IRS** – 0.374EngS**

c. The perceived mathematics teaching readiness of the SMPTs in relation to their student-teaching performance

Perceived Readiness	R	R Square	F-value	Regression model & Coefficient significance
Social regard for learning (SRL)	0.264	0.070	4.054**	2.751 + 0.264CS**

** p<0.05, ** p<0.01*

Legend: ApMS -Applied math subjects; AdMS -Advance math subjects; EducS -Education subjects; IRS - ICT-related subjects; EngS - English subjects; CS - Communication skills

readiness in all of the NCBTS components as well as the content knowledge component of their TPACK. Similarly, their EngS grades positively affected their confidence in the pedagogical knowledge and technological pedagogical knowledge components. As discussed beforehand, the AdMS are intended to deepen the content knowledge of the SMPTs. Thus, a profound comprehension of content mathematics may have increased their confidence in teaching, and in content knowledge.

The academic performance of the SMPTs in the IRS component, however, negatively influenced their perceived pedagogical knowledge and technological pedagogical knowledge components. In other words, a high grade in the IRS results to low confidence in the pedagogical knowledge and technological pedagogical knowledge components. This result somehow confirms the prior results that the SMPTs have the highest academic performance in their IRS. It seems, however, that they have struggled in their teaching method as illustrated by their lowest ratings in the teaching method component during their student teaching. This may be a surprising result but in the context of the study, the SMPTs might have understood their ICT-related subjects but the topics in these subjects may not be specifically for Mathematics teaching. They may have anticipated difficulties in utilizing the different technologies in teaching Math, specifically in combining it with the different pedagogies in teaching Mathematics. This result is supported by the findings of Ruggiero and Mong (2013) that although there is a basic course requirement on technology for all teacher education students to take, this course does not necessarily prepare them to integrate technology to their teaching practices. On the other hand, a low academic performance in the ICT-related subjects may still result to a high confidence in the pedagogical knowledge and technological pedagogical knowledge since Mathematics subjects in basic education are commonly taught using lecture methods, which minimally uses digital technologies.

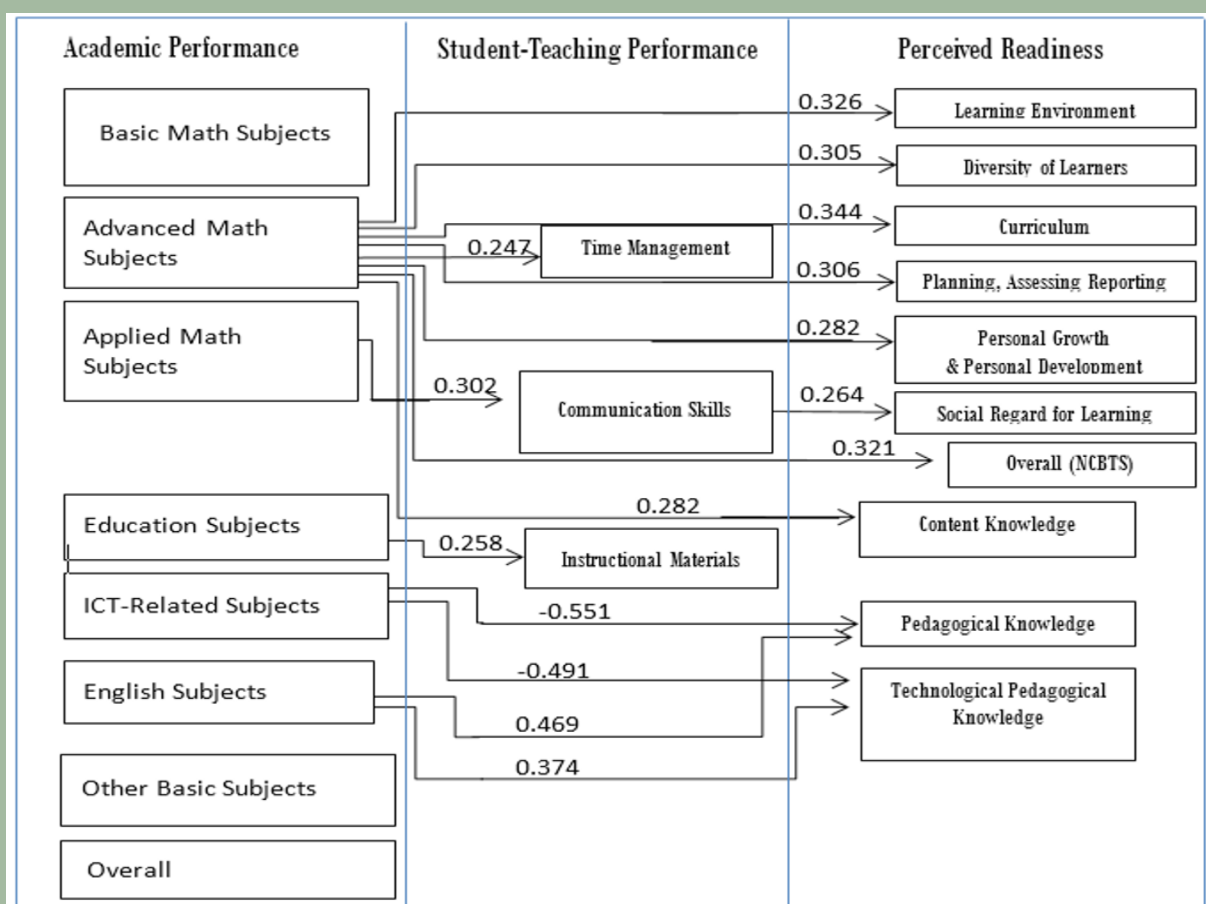

Figure 3. Summary of the interrelationships of the readiness indicators

Lastly, the result indicates that those who achieved high student-teaching ratings in the area of communication skills tend to have high self-confidence in the area of social regard for learning. Specifically, a one unit increase in ratings in the communication skills teaching component results to an increase of 0.264 in their confidence in the social regard for learning. A reasonable explanation could be that those with good communication skills are more likely to be effective in verbally communicating school policies and procedures. He/she may be more conscious in his/her non-verbal gestures like appropriate appearance, setting examples of punctuality and being careful about the effects of his/her behavior on students.

The study; thus, affirms the importance of communication skills in building confidence in teaching Mathematics, specifically on social regard for learning. However, the result might also imply that generally, the student-teaching experience of the SMPTs did not boost their math teaching confidence as it is conceivable that those who excelled in their student-teaching will have higher level of teaching confidence compared to those who struggled in it. This result may raise concerns on the role of the student-teaching experience in building the confidence of the SMPTs in teaching Mathematics.

CONCLUSIONS

The following conclusions have been derived from the study: (1) the SMPTs excelled in their ICT-related subjects, Education subjects and other Basic subjects, while they obtained the lowest grades in the Advanced and Basic Math subjects; (2) the SMPTs have very good student-teaching performance; however, they have the lowest ratings in their questioning skills, lesson integration, and teaching method, which are essential components in achieving critical and analytical thinking as the core goals of math teaching; (3) the SMPTs perceive a lower level of readiness in the content and pedagogy aspects of teaching, which are the core components of the NCBTS; (4) the SMPTs perceive a higher level of confidence in the broader areas of math teaching than in the content areas as indicated by their relatively higher ratings in the NCBTS than in the TPACK constructs; (5) the academic performance of the SMPTs in the Advanced Math subjects and English subjects are important determinants of their mathematics teaching confidence; however, excelling in the ICT-related subjects in college might not be enough to develop high confidence in teaching Mathematics; and (6) the student-teaching performance of the SMPTs in the area of communication skills positively influenced their math teaching confidence in the area of social regard for learning. In general, however, the student-teaching experience of the SMPTs may not have boosted their math teaching confidence; and (7) the SMPTs have inadequate readiness in teaching mathematics relative to the Philippine math education frameworks and standards indicating that content knowledge is the core component of Mathematics teaching preparation and critical and analytical thinking are the main goals of Philippine basic education.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are proposed: TEIs in the region may need to revisit and improve their math teaching preparation programs, most especially in the content preparations of their SMPTs. This may be needed in order to achieve excellence in Mathematics teaching and realize the core goals of Philippine math education in basic education as stipulated in the FPMTE, MFPBE and NCBTS frameworks. Mathematics teaching methods might need to be improved in the education subjects of the SMPTs as this may improve their student-teaching performance.

There may likewise be a need to boost the knowledge confidence of the SMPTs, particularly in the technological, pedagogical, and content knowledge in teaching math as well as in linking math with the community. This is because these appear to be the lowest rated areas in the perceived math teaching readiness indicators. The SMPTs might need to have high academic performance in the Advanced and Applied Math subjects, Education subjects, and English subjects since these generally influence their student-teaching performance and perceived readiness in teaching mathematics.

Similar studies may be conducted to validate and expound the results of the study. Specifically, there is a need to study the readiness of SMPTs in other regions of the country, investigate other possible variables that may influence the readiness of the SMPTs in teaching mathematics, and explore the possible relationships of the readiness of the SMPTs in their licensure examinations, employment opportunities and actual classroom teaching as in-service math teachers.

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