International Journal of Humanities and Social Sciences (IJHSS)
ISSN(P): 2319-393X; ISSN(E): 2319-3948
Vol. 7, Issue 4, Jun - Jul 2018; 147-160

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

STATE INSTITUTIONAL CHARACTERISTICS AND TEACHER QUALITIES: EFFECTS ON CURRICULUM ADAPTATION IN MATHEMATICS TEACHER EDUCATION

***Ferdinand V. Tamoria*[1], *Ma. Nympha B. Joaquin*[2] & *Milagros D. Ibe*[3]**

[1]*Associate Professor, President Ramon Magsaysay State University, Zambales, Philippines*

[2]*Professor, College of Education, University of the Philippines, Philippines*[3]*Professor Emeritus, College of Education, University of the Philippines, Philippines*

ABSTRACT

The study explored how 10 state teacher education institutions (TEIs) in Central Luzon, Philippines adapted the Revised Bachelor of Secondary Education – Mathematics (BSEd-Math) Curriculum for pre-service mathematics teachers. The primary objective was to examine the effects of selected institutional characteristics and qualities of mathematics teacher educators (MTEs) on the extent of curriculum adaptation at the institutional and classroom levels. Utilizing a mixed-methods descriptive-correlational research design, survey data were collected from 10 administrators and 37 MTEs handling BSEd-Math classes in said TEIs. Data were coded, summarized, and analyzed using linear regression and correlation. At the institutional level, number of campuses was found to have a large negative effect on adoption time while SUC level and budget allocation have large negative effects on the degree of innovation. Budget allocation, number of accredited programs, and BSED program accreditation level have large positive effects on compliance level; but only number of accredited programs was found significant. At the classroom level, technological pedagogical content knowledge (TPCK) of MTEs was found to have a moderately positive but significant effect on adoption time while both self-efficacy and TPCK have moderately positive but significant effects on the degree of innovation. MTEs' qualities have no significant effect on compliance level. The study recommends intensifying program accreditation and enhancing teacher self-efficacy and TPCK for successful curriculum adaptation at the institutional and classroom levels.

KEYWORDS: *Curriculum Adaptation, Mathematics, State Institution, Teacher Education*

Article History

Received: *12 Jun 2018* **|** ***Revised:*** *23 Jun 2018* **|** ***Accepted:*** *02 Jul 2018*

INTRODUCTION

The turn of the 21st century marked a period of rapid global economic, technological, and ecological change. More than ever, institutions and citizens need to be ready to adapt to changing environments, technologies, political structures, and social conditions. Learning institutions and educators, therefore, have a critical role in facilitating readiness and adaptability among citizens of society through various forms and levels of education.

Curriculum change in the Philippine educational system has become inevitable in view of the continuing demand for quality education vis-a-vis global trends and standards, especially in science and mathematics education. Significant patterns of change, reforms, and interventions highlighted the hundred years of science and mathematics education in the country particularly in the last two-quarters of the 20th century (UP NISMED & FASE, 2001, p. 167).

It was not surprising, however, that the nationwide implementation of several basic education curricula by the Department of Education (DepEd) generated mixed reactions, especially among teachers, they being primary agents in implementing the curriculum in the classrooms. With the vision of developing empowered learners who have the essential ability for lifelong learning in a dynamically changing world, a great deal of flexibility and adaptability among teachers is needed to put into effect constructivist curriculum innovations in a learning environment where greater interaction is expected among learners, teachers, instructional materials, and information and communication technology (DepEd, 2002a; DepEd, 2010).

High school mathematics teachers, in particular, need to adapt to changes in the mathematics curriculum. From a spiral arrangement of topics in the *Secondary Education Development Program* (SEDP), mathematics content areas in the BEC followed a linear sequence with increased time allotment for practical investigation and problem-solving (DepEd, 2002). With the implementation of the *K to 12 Basic Education Program* beginning School Year 2012–2013, the curriculum has undergone an urgent and critical process of revision, decongestion, and enhancement (DepEd, 2010).

Consequently, Teacher Education Institutions (TEIs) should make their teacher education programs more responsive and relevant to latest developments in basic education. Fulfilling its mandate of formulating and implementing policies, plans and programs for the development and efficient operation of the system of higher education in the country, the Commission on Higher Education (CHED) through the Technical Panel on Teacher Education (TPTE) conducted zonal public hearings on the background, objectives, principles, key features and other considerations about the proposed new Teacher Education Curriculum (TEC) and concluded that teachers are the most critical factors in educational reform and improvement and that the TEIs and the teacher education curriculum have to undergo significant changes to produce teachers who will be powerful agents of educational change (TPTE, n.d.).

Hence, in order to rationalize the undergraduate teacher education programs in the country, in view of the requirements of basic education and to keep pace with the demands of global competitiveness, the Commission issued CHED Memorandum Order (CMO) No. 30, s. 2004 otherwise known as the *Revised Policies and Standards for Undergraduate Teacher Education Curriculum.* This signified the implementation of the new curriculum for Bachelor of Secondary Education (BSEd) and Bachelor of Elementary Education (BEEd) in higher education institutions (HEIs) in the country beginning School Year 2005-2006.

In October 2006, Fr. Nebres, S.J., one of the four pillars of mathematics education in the country, reiterated "If there is any point to be emphasized in these initiatives, it is the focus on the classroom and schoolteachers and on the implemented curriculum" (Nebres, 2006, p. 74). The *Philippine Mathematics Framework for Basic and Teacher Education*, joint project of the Philippine Council of Mathematics Teacher Educators, Inc. (MathTEd) and the Department of Science and Technology-Science Education Institute (DOST-SEI) summarized the output of mathematics experts, educators, and teachers on the proposed standards for basic mathematics education and mathematics teacher education in the country. It serves as a guide for mathematics teachers and educators in the pursuit of quality mathematics education and mathematics teacher education programs from pre-service training to continuing professional development (DOST-SEI & MathTEd, 2006). It remains to be seen, however, how these standards are put into practice to help improve the state of mathematics education in the country. The tragedy continues as long as assessments do not show significant improvements in the quantity and quality of licensed mathematics teachers as well as in the low performance of schools, teachers, and students (Ibe & Ogena, 1998; UP NISMED & FASE, 2001; Ibe, 2007).

As DepEd started the implementation of the K to 12 Program, the TEIs should also be preparing for changes in the teacher education curriculum and all other affected curricular programs. Article 2 of CMO No. 30, s. 2004 assumes that all private HEIs intending to offer teacher education programs or any professional education courses need to secure proper authority from the Commission. However, state universities and colleges (SUCs) or chartered public HEIs established by law are strongly encouraged to strictly adhere to the provisions of said policies and standards. This is a continuing challenge to the SUCs which significantly increased in number in the last two decades but started receiving the limited budget from the national government. Hence, there is a need to look into institutional characteristics of state TEIs as well as relevant qualities of mathematics teacher educators (MTEs), and to examine how these influence the extent of adaptation of the Mathematics Teacher Education Curriculum (MTEC) at the institutional and classroom levels.

Framework of the Study

A modified adaptation of the curriculum framework by Glatthorn, Boschee, and Whitehead (2006) was used to characterize levels of curriculum implementation in this study. Shown in Figure 1 are manifestations of the Mathematics Teacher Education Curriculum as implemented at the national, institutional and classroom levels. The model curriculum recommended by the CHED for implementation at the national level was the basis for analyzing the curriculum supported and adopted by each state TEI at the institutional level. At the classroom level, the study looked into how the TEI-adapted MTEC was adapted and taught by the mathematics teacher educators in their mathematics classes.

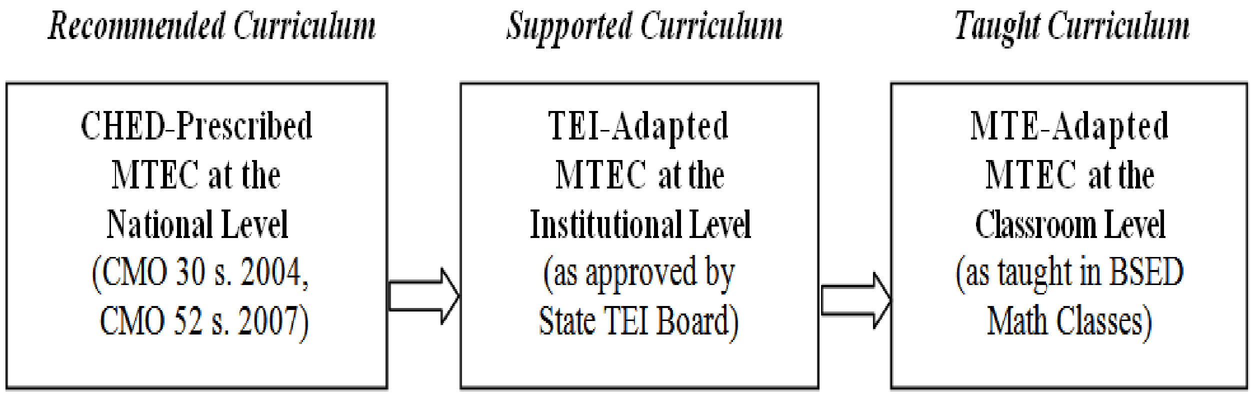

Figure 1: Levels of MTEC Implementation in State TEIs

Shown in Figure 2 is the conceptual framework of the study. The upper inner box on the left represents *Institutional Characteristics* of state TEIs. Specific indicators used are: (a) *Number of Campuses*, (b) *SUC Level* (CMO 60, s. 2007), (c) *Budget Allocation* by the Department of Budget and Management, (d) *Number of Accredited Programs*, (e) *BSEd Program Accreditation Level* by the Accrediting Agency of Chartered Colleges and Universities in the Philippines (AACCUP), and (f) *BSED Program Compliance* based on CHED minimum requirements on teacher education program administration, faculty, library, facilities and equipment, laboratory and cooperating schools, and student admission and retention (CMO 52, s. 2007).

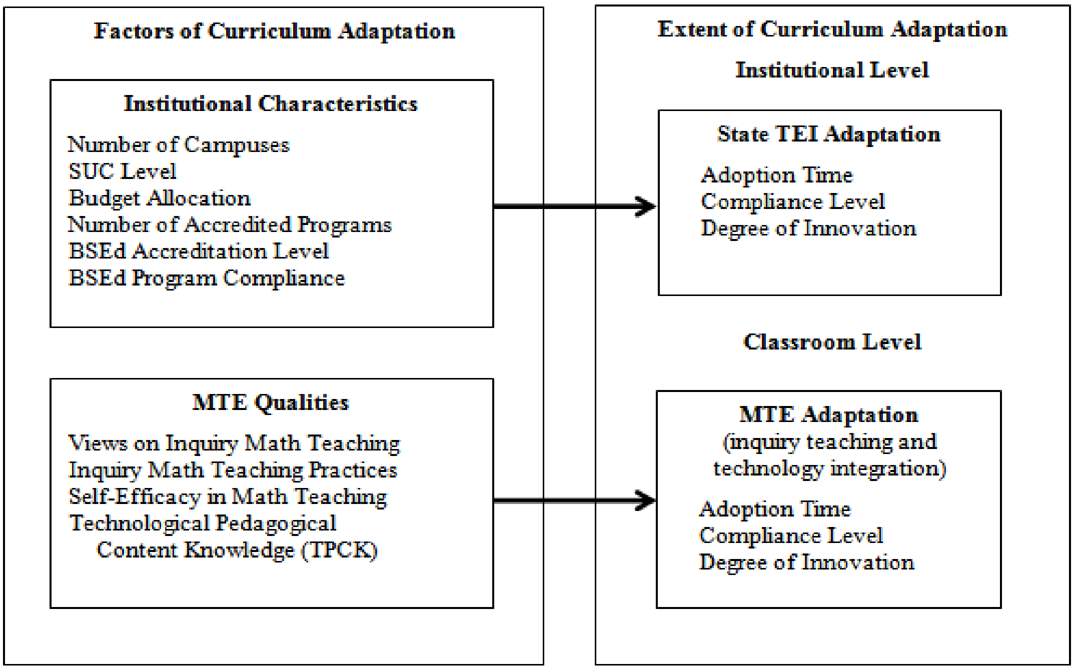

Figure 2: Extent of Curriculum Adaptation in MTEC and Related Factors

The lower inner box on the left represents *Mathematics Teacher Educator* (*MTE*) *Qualities*. Specific indicators are: (a) *Views on inquiry mathematics teaching* based on Inquiry Mathematics and School Mathematics Traditions (Bernardo, 2002; Handal, 2003), (b) *Inquiry mathematics teaching practices* (Bernardo, 2002; Handal, 2003), (c) *Self-efficacy in teaching mathematics* (Bandura, 1994), and (d) *Technological pedagogical content knowledge* (Niess et al., 2009; Schmidt et al., 2009; Landry, 2010).

The right box represents *Extent of Curriculum Adaptation*, with the upper inner box for *Extent of State-TEI Adaptation* at the *institutional level* and the lower inner box for *Extent of MTE Adaptation* at the *classroom level*. Specifically, the extent of curriculum adaptation by the MTEs is based on the use of *inquiry mathematics teaching* in their mathematics classes in the BSED-Math curriculum. Criteria for assessment at the institutional and classroom levels are *Adoption time*, *Compliance level*, and *Degree of innovation*. At the institutional level, *Adoption time* refers to promptness in adopting the MTEC based on the school year the revised BSEd-Math curriculum was implemented by a state TEI. *Compliance level* is based on the percentage of the CHED-prescribed BSED-Math subjects offered by a state TEI. *Degree of innovation* is based on the number of innovations done by a state TEI on the BSEd-Math subjects prescribed by CHED. At the classroom level, *Adoption time* refers to promptness of the MTEs in using inquiry teaching strategies and technologies in their BSEd-Math classes. *Compliance level* is based on the percentage of mathematics subjects taught by the MTEs in which they used inquiry teaching strategies and technologies. *Degree of innovation* is based on how frequently the MTEs used innovations in the BSEd-Math curriculum in terms of inquiry teaching strategies and technologies.

The two arrows from the left boxes to the right boxes represent the causal relationship between *Factors of Curriculum Adaptation* as independent variable and *Extent of Curriculum Adaptation* as *the* dependent variable. Specifically, the six indicators of *Institutional Characteristics* are considered as predictors of *Extent of State TEI Adaptation* while the four indicators of *MTE Qualities* are used as predictors of *Extent of MTE Adaptation.*

Research Objectives

The main purpose of this study was to explore institutional and teacher factors affecting the extent of adaptation of the revised MTEC for pre-service high school mathematics teachers by state TEIs and by MTEs in Central Luzon, Philippines. Specifically, the study aimed to:

- Describe the characteristics of state TEIs and the qualities of MTEs implementing the BSEd-Math curriculum
- Determine the extent of curriculum adaptation by state TEIs and by MTEs as to:
    - Adoption time
    - Compliance level
    - Degree of innovation
- Determine institutional and teacher factors affecting the extent of curriculum adaptation by TEIs and by MTEs at the institutional and classroom levels.

Hypotheses

The following statements about the indicated quantitative variables are the hypotheses formulated and tested in the study:

- Institutional characteristics have a significant effect on the extent of curriculum adaptation by the state TEIs at the institutional level.
- MTE qualities have a significant effect on the extent of curriculum adaptation by the MTEs at the classroom level.

METHODS

Research Design

A mixed-methods research design combining qualitative and quantitative approaches was used to explore the institutional and teacher factors affecting the extent of curriculum adaptation at the institutional and classroom levels. The study was basically designed as a multi-site study with descriptive and correlational perspectives.

Research Setting

Central Luzon or Region III is the largest contiguous lowland area in the vast central plain of Luzon, the largest island of the Philippine Archipelago. The Region is strategically closest to the National Capital Region from the North. Tagged as the *W Growth Corridor of the Philippines* (with its key investment areas forming a letter W), the Region is projected to lead in national development because of its strategic location, tourist destinations, competent and vibrant agricultural sector and special economic zones. The Central Luzon Region is the home of 12 state universities and colleges (SUCs) located in various capitals, cities and other municipalities of the seven constituent provinces. Included in the survey are all the 10 identified state TEIs or SUCs in the Region which offer mathematics as a major field of specialization in the BSEd program. Two of the 12 SUCs in the region were excluded due to their non-offering of the BSEd-Math curriculum. Specifically, the study was conducted at the College or Institute of Teacher Education in the five main campuses, three lone campuses, and two flagship campuses of the 10 identified state TEIs located in three provincial capital cities, two provincial capital towns, two other cities, and three municipalities in the seven provinces of Central Luzon.

Respondents

The respondents of the study consisted of administrators and MTEs from the 10 identified state TEIs in Region III offering the BSEd-Math curriculum. The 10 *administrator* respondents included four deans of teacher education, four BSEd program chairpersons, and two mathematics coordinators. Seven of them are female; three are male. Age-wise, two are in their 50's, while four each are in their 40's and 30's. Four obtained Doctor of Education degrees in educational management; while two were able to earn Ph.D. degrees in mathematics education and in development education, respectively. Four have master's degrees but only two have started doctoral studies. All the administrator respondents are licensed professional teachers with relevant training and experience in teaching, supervision, and management.

The second group of respondents consisted of *mathematics teacher educators* handling mathematics subjects in the BSEd-Math curriculum. A total of 37 or 80% of the 46 MTEs from the 10 state TEIs responded in the actual survey. Nineteen are female and 18 are male. As to age, about 19% are in their 20s, 30% each are in their 30s and 40s, 5% are in their 50s, and 8% are in their 60s. In terms of educational qualification, 24% have doctorate degrees, 38% have masters degrees, and the remaining 38% still have no masters degrees. However, 27% have already started their graduate studies. Unsurprisingly, about 81% have specializations in mathematics. The rest have specializations in engineering (11%), physical science (5%), and computer science (3%). As to eligibility, 73% are professional teachers, 5% are licensed engineers, and 32% are career service professionals. As regards academic rank, about 11% are full professors, 16% are associate professors, and 8% are assistant professors. The remaining 65% are instructors and lecturers. Altogether, the teachers have an average of 15.73 years (*SD* = 11.37) of teaching experience, 9.73 years (*SD* = 9.39) have been for handling mathematics in the BSEd-Math curriculum. Within the last five years prior to the survey, the MTEs had attended an average of two seminars or training and conducted about one seminar or training in mathematics, in teaching, and in technology during the same period.

Instruments

The research instruments consisted of survey questionnaires for each group of respondents and other sources of data like websites of state TEIs, approved BSED-Math curriculum, sample course syllabi, and other documents related to the BSEd-Math curriculum.

The *Survey Questionnaire for Administrators* was prepared to gather data on the institutional profile, characteristics, and relevant information about the implementation of the MTEC. The instrument also sought responses about indicators of institutional adaptation and other concerns relative to the minimum requirements set by CHED on BSEd program administration as stipulated in CMO 30, S. 2004 and CMO 52, s. 2007.

The *Survey Questionnaire for Mathematics Teacher Educators* was designed to gather data on MTEs' profile, qualities, and extent of curriculum adaptation. Parts I and II consisted of 10 items to measure MTEs' views on inquiry mathematics teaching and actual mathematics teaching practices, respectively. The items were constructed using a modified 5-point bipolar self-rating scale based on contrasting pairs of items adapted from the School Mathematics Tradition (SMT) and Inquiry Mathematics Tradition (IMT) by Bernardo (2002). To facilitate analysis, responses to the bipolar rating scales were coded using a 5-point scoring rubric to measure increasing levels of emphasis of *inquiry-based mathematics teaching* (consistent with IMT) as compared to *traditional mathematics teaching* (consistent with SMT).

In Part III, 10 items were constructed to measure MTEs' *Self-Efficacy in Mathematics Teaching* using 5-point self-rating scales based on principles of constructing *Self-Efficacy Scales* (Bandura, 2006). The first five items focused on traditional mathematics teaching competencies while the last five items focused on inquiry-based teaching competencies. Specifically, self-efficacy was measured in each item in terms of increasing levels of confidence to do each corresponding teaching task from 1 (Not confident) to 5 (Very much confident).

Part IV consisted of 10 items adapted from the *Technological Pedagogical Content Knowledge* (TPCK or TPACK) Survey (Schmidt et al., 2009; Landry, 2010). Permission to use an adaptation of the TPACK Survey was granted by Dr. Denise Schmidt of Iowa State University. The adapted items made use of 5-point self-rating scales on selected indicators to measure MTEs' extent of knowledge on the use of technology in teaching mathematics.

In Part V, 10 items were constructed using checklists and open-ended questions to determine MTEs' *Extent of Adaptation* as to *adoption time*, *compliance level*, and *degree of innovation* in using inquiry-based strategies and technology integration in teaching mathematics subjects in the BSEd-Math curriculum based on suggested teaching-learning activities as stipulated in CMO 30 S. 2004 and in the sample course syllabi for mathematics subjects in the CHED-prescribed MTEC.

The survey questionnaires were content validated by mathematics experts from the UP College of Education using 4-point rating scales, yielding high levels (3.75 to 4.0) of *correctness*, *comprehensiveness*, *clarity*, and *usability* as well as positive remarks and suggestions for further improvement. The revised instruments were then tried out in two satellite campuses of a multi-campus state university in the Region. The computed Cronbach alpha coefficients ($\alpha = 0.77$ to 0.85) indicate high internal consistency indicating acceptable reliability. To establish the credibility and validity of the information obtained from the instruments and sources, triangulation techniques were also used in the conduct of the actual study. Survey data from the administrators and MTEs were verified and cross-checked with the data obtained from documentary sources.

Data Collection Procedure

Initially, a preliminary survey was conducted to gather pre-survey data among SUCs in Region III. The actual survey was eventually conducted in the 10 identified state TEIs offering BSEd-Math in the Region. Permission to conduct the study in each state TEI was first requested through a letter addressed to each SUC President. Permission was also requested from the College Dean, the BSEd Program Coordinator, the Mathematics Coordinator, and mathematics teacher educators as respondents of the study. Collection of data from each state TEI involved several phases. First, institutional profile and relevant information concerning the implementation and program administration of the BSEd-Math curriculum were gathered through the survey questionnaire for administrators, websites, site visits, state TEI adapted BSEd-Math curriculum and relevant documents of the 10 state TEIs. Then, profile and qualities, as well as extent of adaptation of the MTEs in BSEd-Math classes, were gathered using the survey questionnaire for MTEs from the 10 state TEIs. Other relevant issues and concerns about the implementation of the revised BSEd-Math curriculum were gathered in the follow-up interviews with mathematics teacher educators who indicated the willingness to be interviewed at the end of the survey questionnaire. Copies of course syllabi for BSEd-Math subjects were also requested to further explore MTEs' extent of curriculum adaptation in their mathematics classes.

Data Analysis Procedure

Institutional characteristics and MTE qualities ,as well as the extent of adaptation of the BSEd-Math curriculum by the state TEIs and by the MTEs, were coded and tabulated to facilitate description and analysis. Initially, responses and observation data were categorized and coded based on observed themes and patterns using 5-point scoring rubrics to facilitate quantitative treatment. Ratings from 1 to 5 indicate very low to very high values of corresponding variables. Descriptive statistics were computed from the quantitative and coded data. Linear regression was used to analyze the effects of institutional characteristics and MTEs' qualities on the extent of curriculum adaptation at the institutional and classroom levels. Profiles of institutions and MTEs were also subjected to critical content analysis and comparative analysis to explore the underlying factors that contributed to their high and low levels of adaptation.

RESULTS AND DISCUSSIONS

The succeeding sections highlight the institutional characteristics of the state TEIs, the qualities of the MTEs, the extent of curriculum adaptation by the state TEIs and by the MTEs, and the factors affecting the extent of curriculum adaptation at the institutional and classroom levels.

Institutional Characteristics

Seven state TEIs in Central Luzon are situated in two or more campuses in their respective provinces while each remaining state TEI has only one campus. Two are Level II SUCs, seven are Level III-A institutions, and one is a Level IV state university. Five receive annual budget allocations below 100 million, four between 100 and 200 million, and one above 200 million PHP from the national government. Five have more than 20 while the other five have below 20 academic programs accredited by AACCUP. Seven have Level III while two have Level II BSEd programs re-accredited by AACCUP. In general, the state TEIs indicated very high (80-100%) compliance with CHED minimum standards for BSEd program administration.

MTE Qualities

The MTEs typically indicated moderate views (M = 2.90, SD = 0.51) and practices (M = 2.83, SD = 0.57) in inquiry mathematics teaching. These imply that the MTEs have eclectic views and practices, putting equal emphasis on both traditional and inquiry mathematic teaching consistent with the findings of Handal (2003), Villena (2004), and Limjap et al. (n.d.). Meanwhile, the teacher respondents typically indicated high levels of self-efficacy (M = 3.82, SD = 0.64) and TPACK (M = 3.69, SD = 0.79). These indicate that the MTEs consider themselves highly confident and knowledgeable about content, methods, and technologies in teaching mathematics similar to the findings of Koh, Chail, and Tsai (2014). These indicate more encouraging results than the findings of Limjap (n.d.) in which MTEs expressed low confidence in teaching major subjects in BSEd-Math during the initial implementation of the revised MTEC.

Extent of Curriculum Adaptation at the Institutional Level

Based on the responses of the administrators and MTEs as well as available documentary sources, the 10 state TEIs adopted the revised BSEd-Math curriculum at different times and came up with various institutional adaptations of the curriculum. Overall, the BSEd-Math curricula of the 10 state TEIs comprised a total of 189 to 198 units and met the CHED minimum requirements for the number of units in general education (71), professional education (51), and specialization (60).

Typically, the institutions demonstrated prompt adoption of the revised curriculum during SY 2006 to 2007. They indicated moderate compliance, offering beyond the minimum required number of units but not using all course descriptions of the general education and specialization subjects in the CHED model curriculum. Typical innovation is done by increasing the number of units (80%), adding a subject (60%), modifying the course description, replacing a suggested subject by another subject (50%), and combining two or more subjects (30%).

Extent of Curriculum Adaptation at the Classroom Level

The MTEs typically indicated prompt adoption (M = 3.66, SD = 0.88), moderate compliance (M = 2.85, SD = 1.09), and high innovation (M = 3.64, SD = 0.85) in the use of problem solving, practical work, cooperative learning, mathematical investigation, and related inquiry teaching-learning strategies in their BSEd-Math classes. However, they typically indicated late adoption (M = 2.64, SD = 1.11), low compliance (M = 2.01, SD = 0.76), and moderate innovation (M = 2.54, SD = 1.11) on the use of graphing calculators, computer algebra systems, electronic spreadsheets, multimedia presentation, Internet and web technologies.

Factors of Curriculum Adaptation at the Institutional Level

Through linear regression, institutional characteristics were used to predict the extent of curriculum adaptation at the institutional level. With a sample size of only 10 state TEIs in Central Luzon, simple linear regression (SLR) was used with only one predictor variable entered in each regression model. Using SLR, the computed beta (β) or standardized regression coefficients represent the simple linear correlation between each predictor variable and extent of curriculum adaptation. The coefficients of determination (r^2) indicate the corresponding proportions of variation in the extent of adaptation explained by each predictor variable. Meanwhile, the analysis of variance for each regression model and the t-test for the corresponding regression coefficient are equivalent and yield the same level of significance for the effect of each predictor variable on the extent of curriculum adaptation. An effect size above 0.5 is considered large Cohen (1992). Tables 1 to 3 show the results of linear regression between institutional characteristics and the three indicators of the extent of curriculum adaptation.

Compared to the other predictor variables in Table 1, only *number of campuses* has a large but negative effect (-0.58) on *adoption time,* explaining about 33 percent variation in the time of adoption by the state TEIs. Hence, state TEIs with more campuses tend to have more delayed adoption of the revised curriculum than those with only one or few campuses. The rest of the institutional characteristics have trivial to small positive effect on adoption time as revealed by the beta coefficients below 0.3. With p-values larger than 0.05, however, not one of the institutional characteristics is a significant predictor of *adoption time*. Each corresponding t-test failed to reject the null hypothesis that the linear regression coefficient is zero.

Table 1: Linear Regression between Institutional Characteristics and Adoption Time (N=10)

Institutional Characteristics	Adoption Time			
	Beta	r^2	*t(8)*	*p*
Number of Campuses	-0.58	0.33	-1.96	0.08
SUC Level	0.02	0.00	0.06	0.95
Budget Allocation	0.25	0.06	0.71	0.50
Number of Accredited Programs	0.02	0.00	0.05	0.96
BSEd Program Accreditation Level	0.20	0.04	0.57	0.59
Program Administration Compliance	0.14	0.02	0.39	0.70

Meanwhile, in Table 2, *number of accredited programs* has the largest positive effect (0.74) on *compliance level*, followed by *budget allocation* (0.60) and *BSEd program accreditation level* (0.56). Each corresponding coefficient of determination indicates more than 30 percent variation in the compliance level. Hence, the state TEIs with more accredited programs, greater budget allocation, and higher program accreditation levels tend to have higher levels of compliance with the prescribed subjects in the revised curriculum than their counterparts. On the other hand, the effect of *SUC level* on compliance level is moderately positive (0.48) while *number of campuses* is moderately negative (-0.44). However, only the corresponding test statistic $t(8) = 3.08$, $p < 0.05$ indicates rejection of the null hypothesis that the linear regression coefficient is zero. Hence, *number of accredited programs* is the only predictor variable found to have a significant effect on *compliance level.*

Table 2: Linear Regression between Institutional Characteristics and Compliance Level (N=10)

Institutional Characteristics	Compliance Level			
	Beta	r^2	*t(8)*	*p*
Number of Campuses	-0.44	0.19	-1.39	0.20
SUC Level	0.48	0.23	1.55	0.16
Budget Allocation	0.60	0.36	2.13	0.07
Number of Accredited Programs	0.74	0.54	3.08	0.02*
BSEd Program Accreditation Level	0.56	0.31	1.91	0.09
Program Administration Compliance	0.19	0.04	0.56	0.59

* *significant, p < 0.05*

On the other hand, as shown in Table 3, *number of campuses* has a positive but small effect (0.14) while the other institutional characteristics manifest a negative effect on the *degree of innovation*. The predictors with the greatest negative effect are *budget allocation* (-0.59) and *SUC level* (-0.53), explaining 35% and 28% variation, respectively, in the degree of innovation. This may imply that the institutions with low budget allocations and SUC levels tend to show a higher degree of innovation, with more innovations and modifications made on the BSEd-Math model curriculum than the other state TEIs. Not one of the predictor variables, however, was found to be a significant predictor of degree of innovation, with p-values greater than the 0.05 level.

Table 3: Linear Regression between Institutional Characteristics and Degree of Innovation (N=10)

Institutional Characteristics	Degree of Innovation			
	Beta	r^2	*t(8)*	*p*
Number of Campuses	0.14	0.02	0.40	0.70
SUC Level	-0.53	0.28	-1.77	0.12
Budget Allocation	-0.59	0.35	-2.09	0.07
Number of Accredited Programs	-0.24	0.06	-0.70	0.50
BSEd Program Accreditation Level	-0.22	0.05	-0.64	0.54
Program Administration Compliance	-0.06	0.00	-0.16	0.88

Analysis of qualitative data showed recurrent themes concerning accreditation areas for factors related to institutional adaptation. Based on the problems, actions and recommendations mentioned by the respondents, the leadership of administrators, knowledge and participation of stakeholders, number of qualified and trained faculty, availability and adequacy of resources, as well as linkages with other agencies are positively associated with adoption time and compliance level. These, however, are negatively related to the degree of innovation, depending on the number of modifications done on the list of mathematics subjects in the CHED model curriculum. Effective school leadership and culture and tradition of excellence through quality school services, professional development of teachers, as well as provision and efficient management of resources, facilities and equipment are success indicators in effective science and mathematics education (Ogena & Brawner, 2004). These identified themes are also among the factors found to be influencing or hindering implementation of a new curriculum in one country (Schagen, 2011).

Factors of Curriculum Adaptation at the Classroom Level

Similarly, linear regression was used to analyze the causal relationship of MTEs' qualities to extent of curriculum adaptation at the classroom level. As shown in Tables 4 to 6, the four selected qualities of MTEs have small to moderate positive effects on the extent of adaptation as indicated by the beta coefficients between 0.2 and 0.5.

In Table 4, only TPCK was found to be a significant predictor of adoption time (t = 2.55, df = 35, p < 0.05), explaining 16 percent variation in the adoption time of inquiry-based teaching strategies. Hence, the higher the level of technological pedagogical content knowledge of the MTEs, the earlier they tend to adopt the use of inquiry-based teaching strategies in their mathematics classes. This further implies that the more knowledgeable the teachers are about how to teach mathematics with technology, the earlier that they apply (especially the more recent) inquiry-based teaching strategies in mathematics.

Table 4: Linear Regression between MTE Qualities and Adoption Time (n=37)

MTE Qualities	Adoption Time			
	Beta	r^2	***t(35)***	***p***
Views on Inquiry Teaching	0.22	0.05	1.30	0.20
Inquiry Teaching Practices	0.31	0.09	1.89	0.07
Self-Efficacy in Teaching	0.26	0.07	1.62	0.12
TPCK	0.40	0.16	2.55	0.02*

***** *significant, p* < 0.05

As shown in Table 5, the beta coefficients between 0 and 0.3 indicate the low correlation between compliance level and the four MTE qualities, each explaining less than 10% variation in the level of compliance. Hence, not one of the qualities was found to have a significant effect on compliance level as revealed by the corresponding t-tests with p-values exceeding 0.05.

Table 5: Linear Regression between MTE Qualities and Compliance Level (n=37)

MTE Qualities	Compliance Level			
	Beta	r^2	***t(35)***	***p***
Views on Inquiry Teaching	0.04	0.00	0.25	0.81
Inquiry Teaching Practices	0.14	0.02	0.77	0.45
Self-Efficacy in Teaching	0.28	0.08	1.65	0.11
TPCK	0.29	0.08	1.71	0.10

In Table 6, views and practices in inquiry mathematics teaching have a small effect (p < 0.3), while self-efficacy in teaching and TPCK have a moderate positive effect (0.3 < p < 0.5) on the degree of innovation. Moreover, the corresponding t-tests indicate that self-efficacy and TPCK are significant predictors, each explaining about 40 percent variation in the degree of innovation. Hence, the teachers with greater confidence and knowledge about teaching content with technology tend to apply more frequently inquiry-based teaching in their mathematics classes.

Table 6: Linear Regression between MTE Qualities and Degree of Innovation (n=37)

MTE Qualities	Degree of Innovation			
	Beta	r^2	***t(35)***	***p***
Views on Inquiry Teaching	0.16	0.03	0.98	0.34
Inquiry Teaching Practices	0.05	0.003	0.27	0.79
Self-Efficacy in Teaching	0.39	0.16	2.46	0.02*
TPCK	0.41	0.17	2.59	0.01*

***** *significant*, $p < 0.05$

The small effects of the first two MTE qualities (views and practices in inquiry mathematics teaching) to extent of curriculum adaptation could be attributed to their typical eclectic and moderate views and practices in inquiry mathematics teaching consistent with the findings of Limjap et al. (n.d.), Handal (2003), and Villena (2004). This partially supports the findings of a study by Judson (2006) which found no significant relationship between teachers' self-reported beliefs and observed teaching practices with technology integration, but contradicts the findings of Vermeulen et al. (1996) that strongly held views on teaching and emphasis on formative inquiries are success factors of curriculum innovation in mathematics. Providing a better explanation for the teacher educators' extent of curriculum adaptation, however, are self-efficacy (Graham & Weiner, 1996) and TPCK (Koh, Chail, & Tsai, 2014) in mathematics teaching. The significance of these two qualities of mathematics teacher educators as predictors of curriculum adaptation extent validated the descriptive statistics which indicated typically high levels of self-efficacy and TPCK as well as early adoption and the high degree of innovation in inquiry-based activities but late adoption, low compliance, and moderate innovation in technology integration.

CONCLUSIONS

Typically, the multi-campus, Level III-A state TEIs with annual budget allocations from the national government has a very high program compliance with a number of programs accredited by AACCUP, including the BSEd program with Level III re-accredited status. The MTEs have eclectic views and practices in inquiry mathematics teaching as well as high levels of self-efficacy and TPCK in teaching mathematics.

The state TEIs typically manifest extent of curriculum adaptation through prompt adoption, high compliance, and moderate innovation of subjects in the revised BSEd-Math curriculum. At the classroom level, the MTEs typically show early adoption, moderate compliance, and high innovation in inquiry teaching; but late adoption, low compliance, and moderate compliance in technology integration.

At the institutional level, a number of accredited programs is a significant factor of compliance level. At the classroom level, TPCK in teaching mathematics is a significant factor in adoption time while both self-efficacy and TPCK are significant factors of the degree of innovation.

Therefore, state TEIs should intensify development efforts in quality assurance and accreditation of BSEd-Math and other academic programs for continuous upgrading of institutional capabilities, efficient management of resources, and effective implementation and delivery of curricular programs and services. The MTEs should continuously enhance their qualifications and qualities like self-efficacy and TPCK for efficient and effective implementation of the curriculum at the classroom level.

REFERENCES

1. *Bandura, A. (1994). Self-Efficacy. In V. S. Ramachaudran (Ed.), Encyclopedia of Human Behavior (Vol. 4, pp. 71-81). New York: Academic Press.*
2. *Bandura, A. (2006). Guide for constructing self-efficacy scales. Retrieved August 12, 2011 from http://www.des.emory.edu/mfp/014-BanduraGuide2006.pdf*
3. *Bernardo, A.B.I. (2002). Filipino college mathematics teachers beliefs about learning and teaching: Reckoning with the school mathematics and the inquiry mathematics traditions. Learning Edge 3, 44-77. DLSU-CSB.*
4. *Cohen, J. (1992). A power primer. Psychological Bulletin, 112 (1), 155-159. doi:10.1037/0033-2909.112.1.155.*
5. *Commission on Higher Education (CHED). (2004). CHED Memorandum Order (CMO) No. 30, s. 2004.*
6. *Commission on Higher Education (CHED). (2007). CHED Memorandum Order (CMO) No. 52, s. 2007.*
7. *Department of Education (DepEd). (2002). Operations handbook in 2002 Basic Education Curriculum: Secondary level. Pasig City, Philippines.*
8. *Department of Education. (2002a). The 2002 Basic Education Curriculum. Pasig City, Philippines.*
9. *Department of Education. (2010). Discussion paper on the Enhanced K+12 Basic Education Programs. Retrieved September 22, 2010 from http://www.deped.gov.ph/cpanel/uploads/issuancelmg/K12new.pdf*
10. *Siti Maimunah, Principles of Assessment: Mathematics Teacher Perceptions, IMPACT: International Journal of Research in Applied, Natural and Social Sciences (IMPACT: IJRANSS), Volume 6, Issue 5, May 2018, pp. 31-42*
11. *Department of Science and Technology - Science Education Institute (DOST-SEI) & Philippine Council of Mathematics Teacher Educators (MathTEd), Inc. (2006). Framework for mathematics teacher education. Working Draft. Manila: DOST-SEI & MathTEd.*
12. *Glatthorn, A. A., Boschee, F. & Whitehead, B. M. (2006). Curriculum leadership: Development and implementation. Thousand Oaks, CA: Sage Publications, Inc.*
13. *Graham, S., & Weiner, B. (1996). Theories and principles of motivation. In D. C. Berliner & R. C. Calfee (Eds.) Handbook of educational psychology (pp. 63-84). New York: Simon & Schuster Macmillan.*
14. *Handal, B. (2003). Profiling teachers: Constructivism- and behaviorist-oriented mathematics". The International Online Journal of Science and Mathematics Education. 3. University of the Philippines, National Institute for Science and Mathematics Education. Retrieved from http://www.upd.edu.ph/~ismed/online/articles/profiling/study.htm*
15. *Ibe, M.D. (2007). Mathematics teacher preparation: The continuing tragedy. Intersection, 8(2), 36-47.*
16. *Ibe, M.D. & Ogena, E. B. (1998). Science education in the Philippines: An overview. In E. Ogena and F. Brawner (Eds.). Science Education in the Philippines: Challenges for Development, (pp. 7-28), NAST-SEI: Center for Integrative and Development Studies.*
17. *Koh, J. H. L., Chail, C. S., & Tsai, C. C. (2014). Demographic factors, TPACK constructs, and teachers' perceptions of constructivist-oriented TPACK. Educational Technology & Society, 17 (1), 185–196.*

18. Landry, Geri A. (2010). Creating and validating an instrument to measure middle school mathematics teachers' technological pedagogical content knowledge (TPACK). Doctoral dissertation, University of Tennessee. Retrieved July 25, 2011 from http://trace.tennessee.edu/utk_graddiss/720.

19. Limjap, A. A., Diaz, R. V., Pulmones, R. K., Cruz, C. C., Gomez, M. A., Lagrimas, L. L., Rodriguez, A. A., Romero, J. M., & Tumala, A. S. (n.d.). Problems and challenges in implementing the New Teacher Education Curriculum (NTEC) in mathematics education. Retrieved February 7, 2009 from http://dg.icme11.org/document/get/339

20. Nebres, B. F. (2006). Reflections on carrying out mathematics education reform in the Philippine setting. In MathTEd Special Conference 2006 Proceedings, October 2006, Ateneo de Manila University.

21. Niess, M.L., Ronau, R.N., Shafer, K.G., Driskell, S.O., Harper, S.R., Johnston, C., Browning, C., Özgün-Koca, S.A. & Kersaint, G. (2009). Mathematics Teacher TPACK Standards and Development Model. Contemporary Issues in Technology and Teacher Education, 9(1), 4-24. AACE. Retrieved July 1, 2011 from http://www.editlib.org/p/29448.

22. Ogena, E. B. & Brawner, F. G. (2004). Effective practices in science and mathematics education: A benchmarking project. Capsule Report. Department of Science and Technology-Science Education Institute.

23. Schagen, S. (2011). Implementation of the New Zealand Curriculum: Synthesis of research and evaluation. A report. Retrieved March 2, 2014 from http://www.educationcounts.govt.nz/publications/curriculum/implementation-of-the-new-zealand-curriculum-synthesis-of-research-and-evaluation/6.-factors-influencing-implementation

24. Schmidt, D., Baran, E., Thompson, A., Koehler, M.J., Mishra, P., & Shin, T. (2009). Examining preservice teachers' development of technological pedagogical content knowledge in an introductory instructional technology course. Paper presented at the 2009 International Conference of the Society for the Information and Technology & Teacher Education. March 2-6, Charleston, South Carolina.

25. Technical Panel for Teacher Education. (TPTE). (n. d.). Proposed New Teacher Education Curriculum [Powerpoint Presentation]. Zonal Public Hearings.

26. Retrieved January 13, 2007 from http://stednet.sei.dost.gov.ph/teachers/resources/TPTE_Curriculum.ppt

27. UP NISMED & FASE. (2001). One hundred years of science and mathematics education in the Philippines. Quezon City: UP NISMED.

28. Vermeulen, A., Volman, M., & Terwel, J. (1996). Curriculum innovation: The case of mathematics, physics, chemistry and biology in secondary education in the Netherlands. Paper presented at the annual Meeting of the American Educational Research Association, New York, April 8-14, 1996. [ED 394 851]

29. Villena, R. G. (2004). Exploratory investigation of the beliefs and practices of elementary mathematics teachers of high and low performing schools in Metro Manila. Doctoral dissertation, De La Salle University, Manila.