INSTITUTIONAL CHARACTERISTICS, MATHEMATICS TEACHER EDUCATOR QUALITIES, AND EXTENT OF CURRICULUM ADAPTATION

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This dissertation hereto, entitled **"INSTITUTIONAL CHARACTERISTICS, MATHEMATICS TEACHER EDUCATOR QUALITIES, AND EXTENT OF CURRICULUM ADAPTATION"**, prepared and submitted by **FERDINAND VALENZUELA TAMORIA**, in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Education (Mathematics Education) is hereby accepted.

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ABSTRACT

The study aimed to explore institutional characteristics, qualities of mathematics teacher educators (MTEs), and extent of curriculum adaptation by institutions and by MTEs as to adoption time, compliance level, and degree of innovation in adapting the revised Bachelor of Secondary Education-Mathematics (BSEd-Math) curriculum; as well as the effects of institutional characteristics and MTE qualities on extent of curriculum adaptation at the institutional and classroom levels. At the classroom level, curriculum adaptation by the MTEs focused on the use of inquiry mathematics teaching and technology integration in their BSEd-Math classes.

Combining qualitative and quantitative approaches, the mixed-methods research was conducted in 10 state teacher education institutions (TEIs) in Central Luzon offering the BSED-Math curriculum. Initially, survey data were collected from 10 administrators and 37 MTEs from the 10 state TEIs. For the follow-up inquiry, one low-performing, one middle-performing, and two high-performing institutions were selected based on the numbers of their BSED-Math graduates and percentages of passers in the Licensure Examination for Teachers in the last five years prior to the survey. Data were gathered through interviews with MTEs and BSEd-Math students, classroom observations, and related documents. The content validated survey instruments were tried out in two satellite campuses of a state university in the Region, yielding acceptable Cronbach alpha coefficients (0.77 to 0.85). Triangulation was used to establish credibility and authenticity of information. Qualitative data were content analyzed and coded using appropriate rubrics for quantitative treatment. Quantitative data were analyzed using descriptive statistics, linear regression, and correlation. Critical comparative analysis was also used

to explore the underlying factors of curriculum adaptation at the institutional and classroom levels.

Typically, the Level III accredited multi-campus state TEIs with corresponding budget allocations from the national government showed prompt adoption, high compliance, and moderate innovation in their adapted BSEd-Math curricula. The MTEs generally indicated eclectic views and practices that emphasized both traditional and inquiry teaching, as well as high levels of self-efficacy and technological pedagogical content knowledge (TPCK). Likewise, they typically indicated early adoption, moderate compliance, and high innovation in inquiry teaching; but late adoption, low compliance, and moderate innovation in technology integration. Teachers, students, and administrators shared categorically similar perceptions about the MTEs' high innovation in inquiry-based activities but low to moderate use of technology integration. In general, data from the respondents and related documents provided support to the extent of curriculum adaptation by the TEIs and MTEs. From the combined analysis of quantitative-qualitative data, institutional factors of curriculum adaptation include accreditation, structural setup, budget and resources, as well as leadership of administrators, number of qualified faculty, stakeholder participation, and external linkages. However, only number of accredited programs had a significant effect on compliance level. Meanwhile, significant factors affecting teacher adaptation are self-efficacy and TPCK, as well as attendance in and conduct of seminars and training. Additional factors of classroom adaptation drawn from the qualitative data include teaching philosophy, readiness for innovation, and creativity, as well as recurrent themes

like professional development, administrative support, availability of resources, and cognitive demand of subjects.

Suggestions for improving policy and practice were recommended for the TEIs to intensify accreditation and upgrading of facilities with active participation of stakeholders, for the MTEs to continuously improve their qualities like self-efficacy and TPCK for effective curriculum implementation in their classes, and for the national agencies and recognized centers to continue assisting the TEIs through faculty development and curriculum revision in view of the ASEAN integration. Recommendations for further research include conduct of studies with similar or modified research designs, selection of larger sample sizes with random sampling, use of more objective measures, and inclusion of other variables associated with curriculum adaptation to address reliability, credibility, validity, and generalizability of results.

Keywords: mathematics teacher, teacher education, state institution, curriculum adaptation, inquiry teaching, technology integration, self-efficacy, TPCK, mixed methods

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CHAPTER I

INTRODUCTION

Background of the Study

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 the *2002 Basic Education Curriculum* (BEC), the *2010 Secondary Education Curriculum* (SEC), and the *K to 12 Basic Education Program* by the Department of Education (DepEd) generated mixed reactions from the academic community, especially among teachers, they being primary agents in implementing the new curriculum. 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 secondary level mathematics curriculum. From a spiral arrangement of topics in algebra, geometry, statistics and trigonometry 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 again undergoes an urgent and critical process of revision, decongestion and enhancement. The proposed K-6-4-2 Model by DepEd includes two years of senior high school (Grades 11 to 12) so that students would be able to consolidate the acquired academic skills and competencies in Grades 1 to 10 by specializing in academic, applied, or other specialized tracks in preparation for higher education, skills-certification, or self-employment (DepEd, 2010).

Consequently, Teacher Education Institutions (TEIs) can 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:

> Teachers are [the] most critical factors in educational reform and improvement. Teacher education institutions 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 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 limited budget from the national government.

Hence, there is a need to look into institutional characteristics heretofore not studied like number of campuses and number of accredited programs as well as relevant qualities of mathematics teacher educators (MTEs) like self-efficacy and technological pedagogical content knowledge in mathematics teaching, and to examine how these affect extent of curriculum adaptation in terms of adoption time, compliance level, and degree of innovation in adapting the curriculum at the institutional and classroom levels.

Statement of the Problem

The main purpose of this study is to explore how the state teacher education institutions adapted the revised Mathematics Teacher Education Curriculum for pre-service high school mathematics teachers. Specifically, the study seeks answers to the following questions:

1. What are the institutional characteristics of state TEIs offering the BSEd-Mathematics Specialization (BSEd-Math) curriculum as to:

   1.1 number of campuses?

   1.2 SUC level?

   1.3 budget allocation?

   1.4 number of accredited programs

   1.5 BSEd accreditation level

   1.6 BSED program compliance

2. What are the qualities of the mathematics teacher educators handling the revised BSEd-Math curriculum in terms of:

   2.1 views on inquiry mathematics teaching?

   2.2 inquiry mathematics teaching practices?

   2.3 self-efficacy in mathematics teaching?

   2.4 technological pedagogical content knowledge?

3. To what extent have the state TEIs adapted the revised BSEd-Math curriculum in terms of:

   3.1 adoption time?

   3.2 compliance level?

3.3 degree of innovation made?

4. To what extent have the mathematics teacher educators adapted the revised BSEd-Math curriculum in their mathematics classes in terms of inquiry teaching and technology integration as to:

   4.1 adoption time?

   4.2 compliance level?

   4.3 degree of innovation used?

5. What are the factors affecting extent of curriculum adaptation at the institutional and classroom levels?

Significance of the Study

Results of the study can be used by teacher education institutions, higher education institutions, and other learning institutions as bases for assessing their readiness in adopting curriculum innovations in mathematics education and mathematics teacher education especially as they prepare for the implementation of the K to12 Basic Education Program.

The study can generate feedback and provide relevant information to the Commission on Higher Education, policymakers, administrators, curriculum planners, and educators for possible interventions in the implementation of the present teacher education curriculum or for curricular reforms and innovations in the near future.

Results and findings of the study could also serve as benchmarks for upgrading the qualifications, knowledge, skills, competencies, beliefs and practices of mathematics teacher educators *vis-a-vis* the latest updates in the basic education program through various professional development activities.

In the end, teachers and learners from basic education to higher education would benefit from improvements in the quality of teaching-learning processes brought about by innovations and enhancements in the mathematics teacher education curriculum, pre-service training of prospective mathematics teachers, and continuing education and in-service training of teacher educators and cooperating teachers.

Scope and Delimitation of the Study

Data gathering started in February 2012 and was completed in December 2012. The study involved 10 SUC-TEIs in Region III or Central Luzon, Philippines. Research sites were main campuses or teacher education flagship campuses of the SUC-TEIs in Central Luzon which offer the BSEd-Math curriculum.

For the initial survey, respondents from the 10 SUC-TEIs were 10 administrators and 37 mathematics teacher educators. For the follow-up study, respondents from four selected institutions were eight mathematics teacher educators and 32 BSEd-Math students. Six supervisors who observed classes of mathematics teacher educators served as respondents for classroom observation.

CHAPTER II

REVIEW OF RELATED LITERATURE AND CONCEPTUAL FRAMEWORK

This chapter reviews related literature, providing theoretical as well as methodological support for the study. The succeeding sections, arranged in the sequence of presentation of the research problems, highlight the connections or contributions of existing body of related literature to the development of the research. The chapter ends with the presentation of the conceptual framework, the statement of hypotheses, and definitions of terms as used in the study.

Related Literature

Characteristics of teacher education institutions. Higher Education Institutions (HEIs) in the Philippines began in the private sectarian system of education with the establishment of schools owned and operated by Catholic religious orders and congregations. After the coming of the Americans until the 20th century, public schools and state HEIs flourished together with private sectarian as well as private non-sectarian HEIs. Based on their original thrusts, state HEIs at present belong to any of the following categories:

- comprehensive and research-oriented universities
- technology-oriented state colleges and universities
- agriculture-oriented state colleges and universities
- teacher-education-oriented state colleges and universities

Likewise, other public HEIs owned and supported by the government are local universities and colleges, CHED-supervised institutions, specialized HEIS and other government schools (Arcelo, 2003; CHED).

Historically, teacher training institutions or normal schools such as the Philippine Normal School in Manila and other provincial normal schools were created to train high school graduates to become teachers, the purpose of each institution is to establish teaching standards or *norms*. The original normal schools collectively form the *National Network of Normal Schools* (3NS) – five (5) in Luzon, three (3) in Visayas, and two (2) in Mindanao. All have evolved into state universities but three retained their original names.

In 2008, the Philippine Normal University was designated as the country's *National Center for Teacher Education* by virtue of R.A. 9647. Not surprisingly, seven of the normal schools are now Centers of Excellence (COEs); three others are Centers of Development (CODs) for teacher education. Five other state universities and colleges have also been identified as centers for teacher education, three of which are COEs while two others are CODs. Table 1 presents a summary of the most recently identified centers for teacher education as to category of institutions.

Table 1

Categories of Identified Centers for Teacher Education

Identified Centers	SUCs	Private HEIs	Total
Centers of Excellence	10	21	31
Centers of Development	5	7	12
Total	15	28	43

Since 2008, a total of 43 centers for teacher education have been identified by CHED covering 3-year periods: 14 COEs and 5 CODs from 2008-2011, 12 COEs and 5 CODs from 2010-2013, and 5 new COEs and 2 CODs from 2010-2013. From the 43 identified centers, only 15 are state universities and colleges. All others belong to the group of 28 private HEIs whose number is almost twice as many as those coming from state universities and colleges. Of this number, 24 are *autonomous and deregulated* HEIs of which 18 have been identified as COEs and six as CODs. From the remaining four private HEIs, three are COEs and only one is a COD (PNU, 2011; CMO 31 s. 2008; CMO 24 s. 2010; CMO 33 s. 2010).

Republic Act No. 7784 which was enacted into law on August 4, 1994 provides legal bases for strengthening teacher education in the Philippines through the establishment of Centers of Excellence for Teacher Education, creation of the Teacher Education Council and appropriating funds for the said purpose. Expected to lead in the development of responsive teacher education programs and to help strengthen other teacher education institutions (TEIs) especially in their respective regions, the identified centers receive funds for developmental projects including faculty scholarships and research grants.

Two of the oldest among the 10 state teacher education institutions in Central Luzon trace their beginnings in Pampanga before the end of the 19th century. The first was established in 1861 in Bacolor and used to be known as the Oldest Vocational School in Far East Asia. Then in 1885, the second oldest institution began as an agricultural experiment station in Magalang at the foot of Mt. Arayat.

Seven other schools were later established during the first half of the 20th century in the other five original provinces of Central Region (one each in Bataan, Bulacan, and Zambales, and two each in Nueva Ecija and Tarlac). In 1993 before the end of the 20th century, the youngest of the seven institutions came about from the integration of a national agricultural school and a national fishery school into a state college in the province of Aurora, the latest province added to Region III.

The first to be converted to a state college (1954) which also became the first state university (1965) in Central Luzon had evolved from a farm school (1907) established in Muñoz, Nueva Ecija. Subsequently, the other nine schools were also converted to state colleges in the latter half of the 20^{th} century (three in the 1960s, three in the 1970s, and three in the 1990s). Then six state colleges were later converted into state universities (one in the 1980s in Tarlac; three in the 1990s in Bulacan, Nueva Ecija, and Zambales; and two within the first decade of the 21^{st} century in Bataan and in Pampanga). Interestingly, five of the 10 institutions were established originally as farm schools and five were former trade schools. However, four institutions had integrated the agricultural schools in their respective provinces when they were converted to state colleges and universities.

As expected, the first to offer undergraduate degree programs in teacher education was Central Luzon Agricultural College (now Central Luzon State University). As the first state college in the Region, it began to offer Bachelor of Science in Agricultural Education (BSAE) degree program in 1951. Later, four trade schools began to offer Bachelor of Science in Industrial Education (BSIE) in the 1960s. In the 1970s, three other agricultural schools started offering the BSAE program, while another trade school also offered the BSIE program. While nine SUCS have already offered the Bachelor of Secondary Education (BSEd) in the 1980s, the last to be established as a state college in 1993 was also the last to offer the BSEd program.

The undergraduate teacher training program in mathematics was initially offered as an area of specialization in the BSIE program by four SUCs in the 1960s and by another SUC in the 1970s. Eventually, three other SUCs offered mathematics as a specialization in the BSEd program in the 1980s. However, two other SUCs in the Region also offered the BSEd-Math curriculum only in the 2000s.

While TEIs all over the country evolved from various categories and typologies of schools, many other schools continue to offer teacher education programs despite these being among the list of oversubscribed courses. Hence, institutional adaptation to curriculum change necessitates addressing the institutional capability of TEIs in order to sustain the existence and the quality of curricular programs in teacher education.

Number of campuses. SUCs and other HEIs in the country are either single-campus, or multi-campus institutions with branches or satellite campuses like the University of the Philippines, Philippine Normal University, Technological University of the Philippines, Polytechnic University of the Philippines, and Mindanao State University. As of April 29, 2013 there are 110 SUC main campuses and 437 satellite campuses with a total of 547 SUC campuses all over the country. Among the 16 regions, Central Luzon (Region III) has the highest number of SUCs with 12 main campuses, but ranks fourth with 37 satellite campuses after Regions VI, IVA, and IX with 55, 53, and 46 satellite campuses, respectively (CHED, n.d.).

Offering the curriculum at the satellite campuses provides access to more students especially those from the remote towns of the provinces. However, delivering the curriculum at the other branches is not easy compared at the home campus because branch campuses are usually more recently established (Dumbre, 2013). Problems concerning sharing and consolidation of resources including scheduling of rooms, classes, and faculty often arise among and between the parent and satellite campuses. Hence, monitoring and accreditation of these campuses by CHED is imperative to ensure quality in the implementation of the curriculum (Evale, 2015).

SUC level. Leveling of SUCs is a joint undertaking of the Department of Budget and Management (DBM), the Commission on Higher Education (CHED), and the Philippine Association of State Universities and Colleges (PASUC). Assessment of performance of SUCs is based on the following indicators or *key result areas* (KRAs):

1. Quality and relevance of instruction (17 points)
2. Research capability and outputs (8 points)
3. Relations with and services to the community (5 points)
4. Management of resources (5 points)

The SUC Levels and their corresponding equivalent point ratings are summarized as follows:

1. Level I (below 11)
2. Level II (11 –19)
3. Level III-A (20 – 27, with a minimum of 10 points in the first KRA)
4. Level III-B (20 – 27, with a minimum of 6 points in the second KRA)
5. Level IV (28 – 35, with a minimum of 14 points in the first KRA and 6 points in the second KRA)

From the maximum total of 35 points, the institutions should obtain the minimum total points in the corresponding key result areas (CMO 42, s. 2007, CMO 60, s. 2007).

Budget allocation. As chartered public higher education institutions established by law, SUCs are administered and financially subsidized by the government. Annual budget allocation from the government, before final inclusion to the General Appropriations Act (GAA), goes through distinct but overlapping processes of budget preparation, authorization, execution, and accountability and review of a past year's budget. These processes involve various government agencies such as the Department of Budget and Management Development (DBM), *Bangko Sentral*, Department of Finance, National Economic and Development Authority, House of Representatives, Senate, and the Office of the President. The GAA is the legislative authorization that specifies the amount for Personnel Services (salaries, wages, and other personnel benefits), Maintenance and Other Operating Expenses (MOOE), and Capital Outlays for the implementation of various programs, projects, and activities of all government departments and offices for a given year.

Program accreditation. The Accrediting Agency of Chartered Colleges and Universities in the Philippines (AACCUP) evaluates the curricular programs of member institutions usually over and beyond the minimum requirements set by CHED and other appropriate agencies. In *program accreditation*, SUCs and other public HEIs are assessed in these 10 areas:

1. Mission, Goals and Objectives
2. Faculty
3. Curriculum and Instruction
4. Students
5. Research

6. Extension and Community Involvement
7. Library
8. Physical Facilities
9. Laboratories
10. Administration

Assessment in program accreditation make use of AACCUP-developed, program-specific evaluation instruments. The instruments consist of 5-point rating scales for all indicators in the 10 areas. For example, assessment of curriculum and instruction involves determining which among the listed teaching strategies, educational technologies, and laboratory equipment are being used by the faculty in their classes based on the CHED minimum standards.

For a program to be accredited, it must undergo several stages, namely: (a) application, (b) institutional self-survey, (c) preliminary survey visit, and (d) formal visit (Level I and succeeding levels). A program that passed the assessment during the preliminary survey visit by external accreditors is awarded "Candidate status" for a period of two years. For each succeeding formal visit, a minimum grand mean rating in all areas for each corresponding level of program accreditation should be met as follows:

- Level I - Accredited status (3.0)
- Level II - Re-accredited status (3.5)
- Level III - Re-accredited status (4.0)
- Level IV - Re-accredited status (4.5)

To be qualified for institutional accreditation by AACCUP, at least 75 percent of the total number of academic programs of an institution should already be accredited.

Levels of institutional accreditation, descriptive evaluation, and corresponding minimum points to be earned are summarized as follows:

- Level I - good, maturing institution (3.0)
- Level II - good, mature institution (3.5)
- Level III - very good, very mature institution comparable to the top 10% in the country (4.0)
- Level IV - outstanding institution, globally comparable with the best in the world (4.5)

AACCUP has initially conducted institutional accreditation of two SUCs in the country. As the pioneer state university in Region III, Central Luzon State University is the first comprehensive state university in the country to obtain Level II institutional accreditation from AACCUP on August 1, 2011. About two months earlier, Visayas State University in Baybay, Leyte was the first to obtain Level II institutional accreditation for agriculture and education in June 2011.

BSED program compliance. In CMO 52 s. 2007, the CHED set minimum requirements for the program administration of the Revised Curriculum for Undergraduate Teacher Education Programs (CMO 30 s. 2004). CHED issues a *Certificate of Program Compliance* (COPC) to SUCs and HEIs after passing the evaluation based on the minimum requirements for each of the following components.

Administration. As stipulated in CMO 52 s. 2007, the Deans of the College or Institute of Teacher Education should have doctorate degrees in Education or related disciplines. They should be licensed professional teachers with adequate teaching experience in basic education.

Faculty. All of the full-time faculty and at least 50% of the part-time faculty should have master's degrees in education or other allied disciplines. In addition, faculty members handling the professional education subjects are licensed professional teachers. They should have adequate teaching assignments and be provided opportunities for continuing faculty development through completion of graduate degrees, attendance in seminars/workshops/conferences, research and publication of research outputs, conduct of lecture and paper presentations in national/international conferences and symposia, and other faculty development opportunities.

Library. The head librarian should be a licensed librarian with appropriate professional training and master's degree in library and information science. There should be adequate and up-to-date library holdings (number of books and titles), subscriptions to refereed journals and periodicals, and internet access.

Physical facilities. Ideally, each lecture class should have 35 or fewer and a maximum of 50 students, except when special lectures are facilitated for more than 50 students. There should be appropriate laboratory facilities for respective specialization offerings in science and technology.

Laboratory school / cooperating schools. As stipulated in the CMO, a TEI must have a laboratory school. Otherwise, there must be a long-term memorandum of agreement with cooperating schools for the field study and practice teaching of the BSEd students.

Students. There should be selective admission of incoming students as well as retention policies for students beginning to take professional education and specialization courses.

Mathematics teacher educator qualities. A deeper understanding of adaptation to curriculum change involves looking beyond compliance with minimum requirements set by CHED on the program administration of the Mathematics Teacher Education Curriculum. Understanding the characteristics of the mathematics teacher educators is more essential because they are the primary agents in implementing the Mathematics Teacher Education Curriculum in their mathematics classrooms.

Views and practices in inquiry mathematics teaching. Mathematical empowerment through critical and analytical thinking is the goal of Philippine mathematics education (SEI-DOST & MathTEd, 2011a). With the assumption that "mathematics is best learned when students are actively engaged" (Principle 3) and "students' attitudes and beliefs about mathematics affect their learning" (Principle 6), there is a need to look into mathematics teachers' views and practices about inquiry mathematics teaching and examine how these affect their implementation of the mathematics curriculum in the classroom. Teachers' views, beliefs, and teaching practices are crucial to the implementation of a curriculum especially at the classroom level (Fullan, 1991).

Limjap, et al. (n.d.) assessed the readiness of TEIs to fully implement the new teacher education curriculum in terms of curriculum and instruction. Their study explored the readiness of mathematics teacher educators to implement the new curriculum based on their academic preparation and pedagogical content knowledge and beliefs relative to mathematics teacher education. Bernardo, et al. (2003) designed the *Teaching Beliefs and Practices Questionnaire* to measure teachers' pedagogical content knowledge and beliefs using five sub-components of teachers' beliefs and practices in mathematics education. The questionnaire consisted of items on the goals of mathematics education, goals of science education, effective teaching, effective learning activities, and teaching practices based on *School Mathematics Tradition* and *Inquiry Mathematics Tradition* (please see Appendix B), two contrasting traditions in mathematics education according to Bernardo (2002). Moreover, an *Implementation Readiness Questionnaire* was designed to obtain information on the extent of implementation of the new Teacher Education Curriculum. Eighty mathematics teacher educators from the selected TEIs were respondents in both questionnaires while ten mathematics heads/supervisors from the said TEIs participated in the focus group interviews. The results revealed the mathematics teacher educators' eclectic beliefs as shown by the high percentage of responses in both School Mathematics Tradition and Inquiry Mathematics Tradition and by the significant correlation between beliefs and practices in each tradition as well as between practices in the two contrasting traditions. However, the teacher participants lacked readiness to implement the new Teacher Education Curriculum as shown by the mismatch between their high level of pedagogical content knowledge, but low level of self-confidence to teach and facilitate students' learning in the new mathematics courses.

A similar study by Villena (2004) explored the beliefs and practices of mathematics teachers in Metro Manila. Teachers' beliefs were established through questionnaires that focused on the goals of mathematics education, the nature of mathematics teaching and mathematics learning. Teaching practices were established through actual classroom observations. Results of the study indicated that mathematics teachers strongly believed in the School Mathematics Tradition and Inquiry Mathematics

Tradition. Teachers' teaching practices fell midway between the two traditions. However, results indicated no significant relationship between teachers' beliefs and practices.

A study by Handal (2003) characterized mathematics teachers' beliefs and practices based on items that focused on the thematic teaching approaches and the use of problem-solving, cooperative learning, exploratory work, hands-on activity and applications of mathematics to real-life situations. Results of correlation analysis and factor analysis of questionnaire items in the Beliefs and Practice Scales as well as analysis of mathematics teachers' responses to the open-ended questions and interviews suggest the existence of constructivist and behaviorist curricular orientations in the teachers' beliefs and practices in teaching and learning mathematics.

The *Teacher Education and Development Study in Mathematics* (TEDS-M), an international comparative study in 17 countries in 2007-2008, examined how primary and lower secondary mathematics teachers have been prepared by these countries, including the Philippines and four other Southeast Asian nations. Survey data were collected from TEIs, teacher educators, and future teachers in the primary and secondary levels. TEDS-M found a general agreement among the countries on the views of teacher educators and future teachers that "mathematics is a process of enquiry" and requires active student involvement rather than following teacher directions. However, the view that "mathematics is a set of rules and procedures" consistent with the SMT was strongly supported by teacher educators and future teachers from the Philippines and five other countries (Tatto et al., 2012).

Judson (2006) analyzed the relationship between teachers' student-centered beliefs about instruction and nature of technology-integrated lessons with the assumption that teachers who readily integrate technology in teaching are more likely to possess constructivist teaching styles. Thirty-two (32) classroom teachers completed a survey to measure their beliefs about instruction and were directly-observed and rated in their classroom teaching. Results of the study revealed no significant relationship between teachers' self-reported beliefs and observed teaching practices with technology integration lessons. The teachers failed to exhibit technology integration effectively in their teaching practices despite having strong constructivist convictions.

According to Thompson (1992) these studies confirm the complex nature of relationships between teachers' mathematics beliefs and teaching practices. The inconsistent relationships between beliefs and practices based on the findings of the studies could imply that there are other variables which enable teachers to demonstrate their espoused beliefs differently in their actual teaching practices. Content analysis of instruments used in these studies revealed that items focused on teachers' pedagogical content knowledge and beliefs about ideal and effective teaching-learning of mathematics and technology based on the contrasting inquiry-based constructivist teaching and the traditional behaviorist teaching traditions (Limjap, et al., n.d.; Villena, 2004; Handal, 2003; Judson, 2006). With the exception of items in teaching practices in the study by Limjap et al. (n.d.), the instruments did not reflect teachers' own personal beliefs that they can do the task of ideal or effective teaching of mathematics and technology.

Self-efficacy in teaching mathematics. Pajares (2002) examined various meanings of beliefs and mentioned that one particular belief that affects human functioning and is considered at the center of social cognitive theory is self-efficacy.

> Perceived self-efficacy is defined as people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives. Self-efficacy beliefs determine how people feel, think, motivate themselves and behave. Such beliefs produce these diverse effects through four major processes. They include cognitive, motivational, affective and selection processes. (Bandura, 1994, p. 71)

Bandura (2006) emphasized that self-efficacy is concerned with perceived capability and that in constructing self-efficacy scales, the items should be expressed in terms of *can do* rather than *will do*. *Can* is a judgment of capability; *will* is a statement of intention" (p.308).

Research on the application of self-efficacy theory to specific spheres of human adaptation and adjustment provides compelling support for the use of self-efficacy in predicting behavior and guiding the development of effective interventions for problems of adjustment (Maddux, 1995). Based on a number of research findings, Graham and Weiner (1996) concluded that self-efficacy has been a more consistent predictor of behaviors as compared to other motivational constructs.

Specifically, based on Bandura's framework, McGee and Wang (2014) found the Self-Efficacy for Teaching Mathematics Instrument (SETMI) a valid and reliable measure of pedagogy in mathematics and teaching mathematics content. Hence, in addition to pedagogical beliefs and practices, mathematics teacher educators' self-efficacy may provide stronger explanation for their readiness to adapt to the Mathematics Teacher Education Curriculum.

Technological pedagogical content knowledge. Principle 8 of the Framework for Philippine Mathematics Teacher Education (SEI & MathTEd, 2011) states that "Technology plays an important role in the teaching and learning of mathematics. Mathematics teachers must learn to use and manage technological tools and resources well" (p. 7). Likewise, CMO 30 s. 2004 upholds the use of some educational technology, whenever possible, in teaching all courses in the revised curriculum (Section 10). More specifically, encouraging the use of graphing calculators and computer algebra systems in all mathematics subjects in the Mathematics Teacher Education Curriculum necessitates mathematics teacher educators' knowledge on integrating such technologies in teaching mathematics classes.

Several studies used the *Technological Pedagogical Content Knowledge* (TPCK) framework for teachers' integration of technology in teaching based on the interconnection and intersection of knowledge in technology, pedagogy, and content; as well as pedagogical content knowledge (PCK), technological content knowledge (TCK), and technological pedagogical knowledge (TPK). Schmidt et al. (2009) examined pre-service teachers' development of TPCK in an introductory instructional technology course. Niess et al. (2009) proposed mathematics teacher TPCK standards and development model. Burgoyne, Graham and Sudweeks (2010) validated an instrument for measuring TPCK. Harris, Grandgenett and Hofer (2010) tested a TPCK-based technology integration assessment rubric. Landry (2010) created and validated an instrument to measure middle school mathematics teachers' TPCK.

Koh, Chail, and Tsai (2014) examined 354 teachers' knowledge for implementing constructivist instruction with technology using TPCK for Meaningful Learning Survey validated through exploratory and confirmatory factor analyses. Regression analysis revealed that teachers' perceptions of TPCK and technological knowledge had the largest positive relationships with their constructivist-oriented technological pedagogical content knowledge. Results indicated that developing intermediate forms of TPCK contributes to teachers' confidence for constructivist-oriented technology integration.

Meanwhile, Yigit (2014) did a systematic review of literature on pre-service mathematics teachers' development of TPCK using peer-reviewed articles published between 2005 and 2013. Findings show that active involvement in technology-enhanced lessons or courses is the main strategy to develop TPCK and to improve future teaching of mathematics.

Extent of curriculum adaptation at the institutional level. One of the significant events that characterized the continuing efforts toward improving science and mathematics education in the country in the 21^{st} century is changing the curriculum from one form to another (UP NISMED & FASE, 2001).

"Curriculum" as defined in dictionaries commonly refers to a course or courses of study in a school (Curriculum, n.d.), but its meaning evolved in various contexts as used by different authors:

> [Curriculum refers to] all the learning experiences planned and directed by the school to attain its educational goals. (Tyler, 1957, p. 79)

The curriculum of a school is the formal and informal content and process by which learners gain knowledge and understanding, develop skills, and alter attitudes, appreciations and values, under the auspices of the school. (Doll, 1996, p. 15)

The curriculum [consists of]. . . the plans made for guiding learning in the schools … and the actualization of those plans in the classroom, as experienced by the learners and as recorded by an observer; those experiences take place in a learning environment that also influences what is learned. (Glatthorn, Boschee & Whitehead, 2006, p. 5)

Curriculum is also classified in various types and forms by several authors. Goodlad (1979) distinguished curriculum in five levels of manifestation as used in curriculum planning: *ideological*, *formal*, *perceived*, *operational*, and *experiential* curriculum. Glatthorn, Boschee & Whitehead (2006) used similar but more meaningful terms for curriculum implementers: recommended curriculum, written curriculum, supported curriculum, taught curriculum, learned curriculum, and tested curriculum.

A simplified model (Robitaille & Dirks, 1982; Robitaille et al., 1993) as used in studies by the International Association for the Evaluation of Educational Achievement (IEA) distinguished three levels of curriculum: *intended* curriculum (national, social and educational context), *implemented* curriculum (school, teacher and classroom context) and *attained* or achieved curriculum (student outcome and characteristics). This has become the common framework used by member countries and by other participating countries in IEA studies, like the Philippines.

In the Philippines, nationwide implementation of a higher education curriculum is signified through memorandum orders on policies, rules, regulations and standards issued by the government. Higher education institutions (HEIs) used to be supervised by the Bureau of Higher Education under the Department of Education, Culture and Sports (DECS). With the passing of Republic Act No. 7722 (otherwise known as the Higher Education Act of 1994) on May 18, 1994 the Commission on Higher Education (CHED) was created as an independent Commission separate from DECS, and attached to the Office of the President of the Republic of the Philippines for administrative purposes. Thereafter, supervision of HEIs together with 15 other functions became the mandate of CHED.

Because of latest developments relative to the Mathematics Teacher Education Curriculum, institutional adaptation is a major concern among TEIs for successful implementation of reforms in the said curriculum. An important consideration associated with successful management of curriculum change often involves adaptation to the changes brought about by the implementation of the new curriculum. Adaptation can be defined in different contexts. The term "adaptation" is derived from the Latin word *adaptare* meaning "to fit." In biology, it refers to efforts by a species to adjust to changes in its environment. In psychology, *adaptation* or adjustment refers to the psychological processes through which people manage or cope with the demands and challenges of everyday life such as changes in circumstances or conditions (Weiten & Lloyd, 2003).

Adaptation according to Cohen and Ambrose (1999) refers to fitting in conformity, agreement, compliance, or yielding to the environment or situation. It can mean "modification of self to fit the environment" or it may involve "an individual acting on the environment to modify, change or transform it" (p.11). In other cases, it means "creatively adjusting to the subtle nuances of a changing environment" (p. 9).

While adaptation theories, models and applications are also used in other disciplines like arts and literature, engineering and technology, medicine and allied fields like nursing and occupational therapy, review of literature on educational change also provides a number of models for adaptation to change. Three broad phases are commonly observed in studies on educational change. Phase I, or the *initiation phase,* leads up to and includes a decision to adopt or proceed with the change process. Phase II, or the *implementation phase,* covers the initial implementation of change. Phase III, or the *institutionalization phase,* occurs when the change becomes a built-in part of the system (Fullan & Steigelbauer, 1991; Gold & Roth, 1999).

Since its creation in 1994, the Commission already released two CHED Memorandum Orders (CMOs) on the *Revised Policies and Standards for the Undergraduate Teacher Education Programs* offered by higher education institutions in the country (CMO 11 s. 1999, CMO 30 s. 2004). Table 2 shows a summary of the minimum requirements for the Teacher Education Curriculum (TEC) prescribed by CHED in the said CMOs.

The main features of the revised Teacher Education Curriculum (CMO 30 s. 2004) include streamlining of professional education subjects by focusing on a more integrated foundational, theoretical, methodological, and experiential preparation in the various curricular components as well as increase in the number of major subjects. Innovations also include six 1-unit field study subjects which students take simultaneously with their professional education subjects. These provide early practical learning experiences for students to observe, verify, reflect on, and actually experience different components of the teaching-learning processes in actual school settings through field observations and studies that gradually intensify until they undertake their practice teaching. Students also have the opportunity to explore special topics and related issues related to their field of study by taking three 1-unit elective seminars on a range of topics chosen by the TEIs based on the perceived needs of the students and expertise of the faculty.

Table 2

Comparative Summary of CHED Minimum Requirements in the Undergraduate Teacher Education Curriculum

Course/Subject	Minimum Required Units: Previous TEC (CMO 11, s.1999)		Minimum Required Units: Revised TEC (CMO 30, s. 2004)	
General Education		68		63*
Professional Education		48		51
Foundation/Theory/Concepts	15		12	
Methods/Strategies	18**		24	
Special Topics in Education	—		3	
Community Immersion/Field Study	3		6	
Practice Teaching	12		6	
Major/Specialization		36		60
TOTAL		152		174

* *excluding units in Physical Education*
** *with Educational Research, Non-formal Education, Guidance and Counseling*

CMO 30, s. 2004 explicitly mentioned that "all the [professional] courses should be taught using a wide range of learning-teaching approaches and student assessment procedures, including whenever possible, the use of some educational technology" (Section 10). Sections 11 to 14 specify the provisions for the categories of professional education. Section 15 gives a summary of the content courses for BEEd. For the BSEd program, Section 16 specifies that students need to complete 60 units of specialization courses in one of the 10 specified major fields, where Mathematics is the first among the list. Article VI stipulates the minimum requirements for the course specifications which should be complied with by all HEIs. The 3-unit mathematics courses in the Revised BSEd-Math Curriculum prescribed by CHED are:

Fundamentals of Mathematics +
Contemporary Mathematics +
Advanced Algebra
Trigonometry
Plane Geometry [a]
Solid Geometry [a]
Analytic Geometry
Modern Geometry*
Abstract Algebra*
Linear Algebra*
Probability [b]
Elementary Statistics [b]
Advanced Statistics*
Number Theory
Calculus I
Calculus II
Mathematical Investigation and Modeling**
Action Research in Mathematics Education**
Instrumentation in Mathematics**
Seminar in Problem Solving in Mathematics**
Seminar on Technology in Mathematics**
History of Mathematics**

Remarks:

+ *enhanced general education courses in mathematics*
[a] *previously combined as Plane and Solid Geometry*
[b] *previously combined as Probability and Statistics*
* *new specialization courses in higher mathematics*
** *new specialization courses in mathematics education*

From the previous curriculum, the revised curriculum includes 6 units of enhanced general education courses in mathematics, 3 units each of two pairs of specialization courses which were previously combined in the old curriculum, 12 units of higher mathematics courses, and 18 units of mathematics education courses.

As specified in CMO 52, s. 2007 (Addendum to CMO 30, s. 2004) the rules and guidelines for the program administration of the revised Teacher Education Curriculum set minimum requirements for the dean/chair of the unit/college/department, faculty, library, facilities and equipment, laboratory school or cooperating school and student admission and retention. These can serve as bases for assessing capability of the TEIs to adapt to the changes brought about by the implementation of the revised Teacher Education Curriculum.

Prior to CMO 11, s. 1999, a study by Pedro (1996) assessed the effectiveness of the pre-service program for mathematics teachers of seven teacher training institutions based on the existing DECS policies and standards. Quantitative and qualitative analyses of data from survey questionnaires, classroom observations, interviews with prospective and beginning teachers, teacher educators and deans and administrators revealed that the TTIs did not strictly adhere to the DECS policies and standards. Results also showed that there was no definite system of implementation of the pre-service program for mathematics teachers. Self-reports of the respondents indicated that the pre-service program for mathematics teachers is very effective but classroom observations, test results and products of the pre-service program revealed otherwise. Mathematics teachers have inadequate mathematics content and teaching skills and unsatisfactory teaching behavior. Beginning and prospective teachers were weak in observed teaching skills. Findings of the study led to five strong recommendations for the improvement of the pre-service program for mathematics teachers including: strict implementation of the policies and standards in hiring mathematics faculty, formulation of a philosophy as basis for the goals and objectives of the program, and further training of mathematics faculty in mathematics education.

After CHED issued CMO 11, s. 1999, Peralta (2005) assessed the level of effectiveness of the secondary teacher education programs of three selected state universities and colleges in Region III, covering the period School Year 1999-2000 to School Year 2003-2004. Assessment of objective performance measures included enrollment rate, survival rate, graduation rate, percentage of LET passers, employment rate, faculty qualification and student qualification. Assessment of subjective performance measures using a survey questionnaire was based on the perceptions of selected stakeholders as to areas of accreditation by the Accrediting Agency of Chartered Colleges and Universities of the Philippines (AACCUP).

Results indicated that, to some extent, the secondary teacher education programs of the respondent SUCs met the standards of faculty qualifications in terms of educational attainment and teaching experience. But in terms of area of specialization, there was an uneven distribution of faculty teaching assignments especially that some taught courses which were not their field of specialization. The programs adopted selective student admission policy but were somehow lenient in retention policy. There were some inadequacies in student services, faculty development, instructional facilities and instructional practices. These may explain why there was below satisfactory performance assessment in terms of passing rate in the Licensure Examination for Teachers (LET) and employment rate.

Peralta (2005) assessed the general secondary teacher education program based on CMO 11, s. 1999. The results revealed useful insights about compliance of SUC-TEIs *vis-à-vis* the minimum requirements set by the Commission on Higher Education in the first CMO on the Revised Policies Standards for Teacher Education programs since its creation in 1994.

Based on CMO 30, s. 2004, Salazar (2008) determined the extent of implementation of the field study courses in selected TEIs and SUCs in the island provinces of Region IV-B (MIMAROPA) consisting of Mindoro, Marinduque, Romblon and Palawan. The survey, interviews and observations revealed that TEIs have problems in implementing the field study courses. But students, faculty and administrators observed that, to promote quality education, TEIs exerted most efforts in class demonstration (using a variety of teaching approaches, strategies and techniques), faculty development through graduate studies and trainings, and correct interpretation and implementation of CMO 30, s. 2004. The top recommendation made was proper and close coordination and networking among TEIs, SUCs and cooperating schools. Although there are indications that TEIs managed to adapt the field study courses in the new Teacher Education Curriculum, there is also a need to assess how they implement the specialization courses.

Kulikova (2007), in a qualitative study, examined institutional adaptation of Russian universities to the changing socioeconomic conditions through case studies of three public universities based on the resource-dependence theory of organizational adaptation. Results revealed that although there were certain similarities in the descriptive and analytic variables observed from the pedagogical, technical and architectural universities; the institutions manifested different pictures of institutional adaptation and certain dynamics specific to each institution.

In this study, since institutional profile was also described via the minimum requirements set by the CHED on the program administration of the Mathematics Teacher Education Curriculum, capacity and capability building is imperative especially in terms of faculty, facilities, and other resource requirements for the SUC-TEI to adapt to the changes that come with the implementation of the revised curriculum, especially at the classroom level.

Extent of curriculum adaptation at the classroom level. The *Concerns-Based Adoption Model* provides three instruments to assess adoption of an innovation. The *Stages of Concern* (SoC) questionnaire is used to measure teachers' concerns about an innovation they are expected to implement. The process involves seven stages of concern: awareness, information, personal, management, consequence, collaboration and refocusing (Hord et al., 1998).

These stages of concern may be grouped together to correspond to the three phases of change. The first two stages (awareness, information) correspond to the *initiation* phase, the next two stages (personal, management) correspond to the *implementation* stage and the last three stages (consequence, collaboration and refocusing) correspond to the *institutionalization* stage (Gold and Roth, 1999).

Based on observations from intensive studies of the change process, Doll (1996) listed common principles associated to successful management of change in people and organizations:

> They must be made aware of the possibility of changing... be made interested in a proposed change... must have time to consider the worth of the change... must try it for themselves on a small or limited scale. If the change withstands the test they apply, they may accept the change for future use. (Doll, 1996, p. 325)

For Gold and Roth (1999), bringing about educational change usually involves essential issues such as clearly defining beliefs and goals, understanding the process of change and assisting individuals and organizations successfully through the process, involving teachers in frequent and continuous planning, assisting teachers and administration in working together, selecting a model of change that meets the needs of specific schools and case individuals, and training "helping professionals" to become successful agents of change.

Limjap, et al. (n.d.) conducted a study on the readiness of ten TEIs with a mathematics education program selected from university and non-university HEIs in the National Capital Region. In the study, the readiness of the TEIs for the new teacher education curriculum in mathematics education was defined as the ability to fully implement it in terms of curriculum and instruction and available resources. The study also looked into the readiness of the mathematics teacher educators to implement the new teacher education curriculum in their mathematics classes. While results indicate the need for more institutional support in terms of learning materials, facilities and technologies, there is also a need to train the mathematics teacher educators themselves especially with regard to clarifying the vision and goals of the new Teacher Education Curriculum so that they could reflect and appreciate why the new mathematics teacher education curriculum is anchored on the inquiry mathematics tradition.

Focus on inquiry and 21st century skills. According to Vicencio (2007), the revised policies and standards of the revised curriculum identified competencies for future teachers as well as varied skills that they should master. Basically, they should have mastery of *teaching process skills* like:

- curriculum development;
- lesson planning;
- materials development;
- educational assessment;
- teaching approaches.

More importantly, as future educators, they are expected to have *research skills* and essential *life skills* such as:

- effective communication;
- critical thinking;
- problem solving;
- decision-making.

The design of the new Teacher Education Curriculum matches the preparation of teachers with the needs of society in the 21st century. It is comparable to the teacher education model designed as early as the 1980s – field-based, problem-centered, technology-driven, developmental, competency-based, and presumes lifelong learning (Tetenbaum & Mulkeen,1986).

Aside from the increase in number of units and specialization courses, pertinent changes in the revised Teacher Education Curriculum for mathematics teachers are explicitly indicated in the sample course syllabi for the CHED-prescribed mathematics teacher education curriculum. For example, Fundamentals of Mathematics and Contemporary Mathematics are integrative courses characterized by:

- emphasis on conceptual understanding more than just procedural understanding;
- focus on problem solving using real-life situations, investigations and modeling based on the principle that mathematics is useful, realistic, relevant, interesting, and needed by all;
- engaging learners in reflective thinking, and to "think outside the box."

Courses in mathematics education like History of Mathematics, Seminar in Problem Solving, Technology in Mathematics, Mathematical Investigation and Modeling, Instrumentation in Mathematics, and Action Research in Mathematics Education bring new perspectives in teaching mathematics. Inclusion of these courses as well as content analysis of sample course syllabi in the CHED-prescribed Mathematics Teacher Education Curriculum manifest the inquiry-based nature of pre-service education required of prospective mathematics teachers in basic education that focuses on critical thinking, problem solving, and other higher-order thinking skills (DepEd, 2002; DepEd, 2010).

The implementation of the Enhanced K to 12 Basic Education Program also entails special consideration in the offering of major subjects in the Mathematics Teacher Education Curriculum. The Curriculum Guide for Mathematics (DepEd, 2012) describes the conceptual framework, course descriptions, content, standards, and learning competencies in mathematics from Grade 1 to Grade 10. With the twin goals of critical thinking and problem solving, the K to 12 mathematics curriculum is grounded on learning principles and theories such as *Experiential and Situated Learning*, *Reflective Learning*, *Constructivism*, *Cooperative Learning* and *Discovery and Inquiry-Based Learning*. These guiding principles as well as the adopted five content areas (Numbers and Number Sense, Measurement, Geometry, Patterns and Algebra, and Probability and Statistics) conform to the standards of the Mathematics Framework for Philippine Basic Education (SEI & MathTEd, 2011).

Integration of technology and related concerns. Section 10 of CMO 30 s. 2004 specified the use of educational technology in teaching all courses in the revised curriculum. Compared to the previous curriculum, encouraging the use of graphing calculators, computer algebra systems, and appropriate technology in all mathematics subjects is explicitly mentioned in the course description of mathematics subjects in the revised CHED model curriculum. Moreover, Seminar on Technology in Mathematics is included among the new mathematics education courses in the revised curriculum because appropriate technologies can be used in visualizing and solving many real-world problems.

Integrating information and communication technology ICT) in the mathematics classroom is another indicator associated to adoption of inquiry-based and constructivist teaching. This is because ICT integration is often implemented through learner-centered activities such as drill and practice, simulation, game, tutorial, computer-based laboratory, computer-assisted instruction, and web-based learning (UP NISMED, 2003, pp.35-36).

MSC Malaysia (2007) also supports the claim that ICT integration is an indication of inquiry-based teaching practices:

> The effectiveness of ICT could be maximized and… potentials realized by integrating ICT into teaching practices that are consistent with constructivist pedagogy, in which students are actively engaged in their own learning. (p.7)

Content analysis of the mathematics curriculum in Grades 11 and 12 provides additional insight on possible changes in the curriculum for pre-service mathematics teachers. A survey of the mathematics curriculum in grades 11 and 12 of 11 countries and of the International Baccalaureate (IB) reveals a wide variety of topics from various areas of mathematics. While curricula differ among countries and states, lessons covered include topics from number theory, advanced algebra, linear algebra, plane and solid geometry, trigonometry, analytic geometry, differential and integral calculus, logic, set theory, discrete mathematics, probability, statistics, and business mathematics (Future School, n.d.).

The wide variety of topics covering different branches and areas of mathematics in spiral arrangement, therefore, requires senior high school mathematics teachers to have a more extensive and in-depth background in mathematics specialization courses. This further confirms the need for curriculum revision consistent with the findings that

> the curriculum for mathematics majors had overlapping content and dwelt too much on lower level mathematics. . . Because of the mathematics practices often used by their professors, lecture was rated by graduating seniors and beginning

teachers as the most appropriate method for teaching mathematics. (UP NISMED & FASE, 2001, p. 153)

These have a number of implications on the Mathematics Teacher Education Curriculum being offered by TEIs in the country. Curriculum adaptation should continue to be the primary concern of institutions and educators, especially while preparations for the K to 12 curriculum implementation are under way.

In the process of preparing themselves, mathematics teacher educators undergo different phases, stages, modes, categories, or other ways and means of adaptation to the Mathematics Teacher Education Curriculum. One of the recommendations of the study by Racela (2005) on the pre-service education of general science teachers is to determine how teachers could be encouraged to fully adopt activity-oriented teaching approaches in order to improve the pre-service teaching-learning processes and practices in teacher education institutions. This recommendation should also be a main concern of mathematics teacher educators as they adopt the Mathematics Teacher Education Curriculum in their mathematics classrooms.

Adoption time. A number of models on adaptation of individuals to change and innovation were developed in different fields and disciplines. Rogers (1995) generalized a model on how technology and innovations spread in different cultures. Depending on the time spent to adopt an innovation, individuals and organizations can be classified into five categories (*innovators, early adopters, early majority, late majority,* and *laggards*) that are spread in a standard normal distribution.

McKeown (n.d.) came up with a model from her reflection on why people [especially teachers] do not adopt ICT or other innovations. Using the *pencil metaphor* somewhat similar to Roger's categories, people can be categorized as: *lead-ers* (early adopters), *sharp ones* (learn from the early adopters), *wood* (would use technology with help from the sharp ones), *dead wood* (can never be sharpened), *eraser* (used to undo what the leaders had done), *hanger-on* (knows technology and attends all seminars but does not do anything). These categories provide a quick recall of the categories of teachers as adopters since the pencil (though considered a traditional tool) is commonly used by teachers.

A review of case studies related to technology integration (CITEd, n.d.) revealed that teachers generally have the eagerness for technology integration. However, they often encounter the following challenges in integrating technology strategies in the classrooms: (1) adequate time to identify and learn compatible and relevant software, (2) scheduling of access to computers, (3) adequate equipment and use, and (4) adequate and timely professional development.

In a study by Marasigan (1994) on technology adoption by members of rice-farmers cooperatives in Region III, response data from the interviews and questionnaires were coded and categorized based on three indicators depending on the nature, degree and time of adoption. While the study focused on technology adoption in the context of agricultural technology, similar categories for classifying extent of curriculum adaptation in mathematics teacher education could be explored in terms of objectives, content, methods, materials and other related considerations.

Compliance level. Whatever decisions the mathematics teacher educators made in implementing the curriculum in their mathematics classes, curriculum adaptations at the classroom level could manifest the behaviorist school mathematics tradition characterized by teacher-centered direct instruction focused on mathematics as a set of rules and operations, or the constructivist inquiry mathematics orientation focused on student-centered inquiry-based learning by discovery and problem solving (Bernardo, 2002; Handal, 2003; Villena, 2004; Judson, 2006; Tatto et al., 2012). Hence, nature of adoption in the study of Marasigan (1994) could be described as *compliance level* in this study as another indicator of curriculum adaptation, assessed in terms of percentage of compliance with the CHED requirements concerning the offering of subjects in the revised BSED-Math curriculum, as well as the use of inquiry-based teaching strategies and technology integration.

Degree of innovation. Instead of degree of adoption in the study of Marasigan (1994) degree of innovation could be used to assess extent of curriculum adaptation in terms of the number of times innovations were introduced in BSED-Math subjects, as well as the frequency of using inquiry teaching and technology integration in BSED-Math classes.

The preceding literature and related studies provided some background and insights on how extent of curriculum adaptation could be assessed. Hence, the above-mentioned concerns that seem acceptable and appropriate had been considered in this study to describe the extent of adaptation of SUC-TEIs and mathematics teacher educators to the Mathematics Teacher Education Curriculum. Eventually, underlying factors that relate to curriculum adaptation at the institutional and at the classroom levels could also be explored.

Factors of curriculum adaptation. A number of factors are often associated to adoption of curriculum innovations. Various studies provide support to different approaches in determining such factors which are related to or significantly predict the adoption of innovations in the teaching-learning environment.

Fullan (1991) identified three concerns that are often at stake when a curriculum is implemented: use of modified or new *materials*, new *practices* like use of new teaching approaches, and alteration of existing *beliefs* of those involved. In this order, use of available materials and teaching with innovations precede change in teaching beliefs. This may imply the need for the TEIs to meet the program administration requirements of Mathematics Teacher Education Curriculum including provision of needed resources and training for the mathematics teacher educators to espouse the new teaching beliefs and practices and successfully adapt the Mathematics Teacher Education Curriculum in the classrooms.

Mc Kenzie et al. (2005) conducted a study which sought to identify and analyze successful cases of "innovations" in the form of ideas, projects and processes which had been disseminated and successfully adopted, adapted, implemented and sustained in contexts beyond the development context. Cases which demonstrated clear evidence or features of improvement in teaching and learning were identified using extensive document analysis and interviews with project developers and adopters identified. Case studies were examined in more detail, focusing on why and how the interacting system of features contributed to the success of 14 innovations which ranged from small-scale resource projects to large-scale internationally disseminated projects with extensive support systems.

A study by Vermeulen et al. (1996) determined success factors in curriculum innovation in mathematics, physics, chemistry and biology in secondary education in the

Netherlands based on interviews with 30-key persons in each subject area (curriculum specialists, subject specialists, researchers, policy makers and teachers). In general, success factors in curriculum innovation were found across academic subjects especially in mathematics where all factors were realized in mathematics innovation: strongly held and detailed views on teaching the subject, emphasis on formative inquiries, community support for the innovation, legitimization of the innovation through new examination structures, positioning of key-persons in key-positions in educational institutions, detailed and tested curriculum materials, involvement of educational publishers, existence of centers for curriculum research and development, stimulating role of a charismatic person in R & D centers, and constant attention to networking (among teachers, curriculum developers and trainers).

Twigg (2000) identified eight pre-conditions that must be in place for an institution to successfully implement technology integration into the teaching-learning process. The following, however, seem applicable to the current situation of HEIs in the Philippines: (a) presence of a mature information technology group to support technology integration, (b) substantial number of faculty members with understanding and experience in technology integration in their classes, (c) demonstrated commitment to learner-centered education, (d) mechanisms for readiness of learners for technology integration, (e) partnership among faculty and staff in planning and implementing technology integration. These criteria are worth considering in view of the strong encouragement for technology integration through the use of graphing calculators and computer algebra systems in all mathematics classes.

ChanLin et al. (2006) did eight case studies of teachers who won an award for creative teaching in order to identify the factors affecting their use of technology in creative teaching. The studies explored the perceptions of the teachers about technology use. The factors that were identified were found to be environmental, personal, social and curricular factors. Environmental factors include computer facilities, budget, computer access, resource management, availability of time, rewarding policy for integrating technology. Personal factors are beliefs about teaching and teaching with technology, personal experience in using technology and trying new things, technology integration as a lifestyle, interest in using computers, need for personal growth. Social factors involve support from peers, supportive supervisors, encouragement from students' achievement and their parents, community support, technology trends and social change, social values in using technology. Curricular factors are curricular objectives to be achieved, skills and literacy to be enhanced, assessment of students' performance, need to integrate existing teachers strategies, teachers' time to prepare classes, nature of the learning subject, ease of handling technology, use of technology and its relation to learning.

Institutional factors. A study by Belleza (2001) on organizational innovation strategy for member institutions of the National Council of Educational Innovators (NCEI) derived six common attributes that are perceived to be essential for member institutions to become an educational innovator: (a) flexible or open to change, (b) creative or resourceful, (c) dynamic or enthusiastic, (d) sensitive to stakeholders' needs, (e) updated in global trends, and (f) risk-taking/empowering. In addition, school administrators are expected to be visionaries while teachers are expected to be critical and reflective thinkers.

Results of the DOST-SEI benchmarking project which identified model elementary and secondary schools that exhibit effective practices in science and mathematics revealed two success formulas. The first formula is effective school leadership. The school leader (principal) inspires the school, gives over-all direction in institutional development, and demonstrates active efforts in resource generation. The second formula involves a school management and structure that fosters a culture and tradition of excellence along components of institutional development in providing school services toward quality education in science and mathematics – curriculum, delivery modes, science and mathematics teachers, school management, science equipment and library facilities, assessment, and financial resource management (Ogena & Brawner, 2004).

Using survey questionnaires, attitudinaires, test results, and classroom observations, Galido (2005) identified facilitative factors in the implementation of the mathematics curriculum in five science high schools in Lanao del Norte and Lanao del Sur. Among the factors of efficient and effective implementation of the curriculum are school-related characteristics including administrators with appropriate graduate degrees and sufficient teaching experience, hiring of faculty with appropriate advanced degrees in their fields of specialization, and fund allocation for faculty development.

Results of a case study by Oates (2009) on the use of computer algebra systems in the undergraduate mathematics curriculum of the University of Auckland revealed six taxonomic components that significantly affect technology integration in mathematics:

access, student facility, assessment, pedagogy, curriculum, and staff facility. Supported by data from surveys, observations and interviews; the study concluded that effective integration of technology in undergraduate mathematics entails a comprehensive attention to the interdependence of the organizational, mathematical, access, assessment, staff, and student factors.

A survey on ICT utilization in Philippine public high schools by Tinio (2002) reported that a majority of the schools do not have enough hardware, peripherals, network technologies, and simultaneous Internet access for technology use. Respondents indicated that the top five among 26 major obstacles to the use of ICT for teaching and learning in the schools include: (a) insufficient number of computers, (b) insufficient technical assistance for operating and maintaining computers, (c) inadequate training opportunities for teachers, (d) limited space to locate computers appropriately, and (e) lack of funds. Hence, efforts toward a more learner-centered and skills-based curriculum require a large investment in terms of hardware, software, network and internet facilities, and faculty and staff training.

A study by Cajilig (2009) on the integration of ICT in teaching mathematics in Metro Manila public secondary schools found that the teachers typically had very favorable attitudes about the use of new technologies. However, the extent of ICT implementation was generally poor due to lack of computer facilities and training programs for teachers. A similar but better situation could be observed among public HEIs considering their smaller number as compared to public high schools.

Teacher-related factors. Sieminski (2010) conducted a case study on adaptations of further education college lecturers to major curriculum change to deepen understanding of factors which influence policy implementation. Analysis of data from documents and interviews indicated that implementing a new educational policy reflects lecturers' prevailing work practices and views about their roles and tasks in carrying out the new policy and that these factors determine their attitudes about the goals and operational procedures of any new policy.

Using survey methodology, Kersaint et al. (2003), examined the beliefs and practices of mathematics teacher educators regarding the integration of technology in their teacher education programs. Relationships among mathematics teacher educators' beliefs about the importance of technology, comfortability in using and teaching with technology, and degree of technology implementation within their mathematics teacher education programs were also examined. Results showed that mathematics teacher educators at the elementary, middle, and high school levels were consistent in their beliefs on technology integration in mathematics teaching. While mathematics teacher educators at the elementary level indicated limited technology integration in mathematics, those at the secondary level focused more on mathematics specific technologies such as graphing calculators and geometry software in their preservice programs.

According to O'Neil and Perez (2003), technology innovations will only be implemented successfully on a widespread basis if the needs and perceptions of all the stakeholders are taken into account. As Mistretta (2005) concluded, "Training teachers to integrate technology coupled with continued investigation into its effects on teaching and learning (mathematics) serve to empower technology-based learning environments." (p. 23).

Results of the study of Limjap, et al. (n.d.) showed that despite having adequate pre-service education and teaching experience in mathematics, only a small percentage of mathematics teacher-educator participants in their study indicated confidence in teaching the new subjects in the revised Teacher Education Curriculum for mathematics such as History of Mathematics, Action Research in Mathematics, Seminar in Technology in Mathematics, Instrumentation in Mathematics, and Mathematical Modeling and Investigation. Teaching these mathematics subjects from different strands (numbers and number sense, measurement, geometry, patterns, functions and algebra, data analysis and probability, analysis, abstract mathematics) involves a variety of cognitive demands such as visualizing, knowing, computing, solving, applying, proving, and rigor. Hence, even experienced educators need to develop self-confidence as they learn how to teach effectively the mathematics subjects in the Mathematics Teacher Education Curriculum.

Results of these studies confirm teacher educators' need for continuing professional development as agents of change especially in view of implementing teaching innovations in the classroom. After all, teachers are the most important agents of the instructional process. Bubb (2005) mentioned a variety of professional development activities that teachers and teacher educators may need to engage in to develop or improve teaching performance like coaching and mentoring, learning conversations with other staff about teaching and learning, self-study on available resources, observing other teachers, visiting centers and schools in action, attending courses, conferences, training/seminars/workshops, and conduct of action research and experiments with teaching innovations.

The Framework for Philippine Mathematics Teacher Education (SEI-DOST & MathTEd, 2011, p. 50) provides a matrix in which continuing professional development programs are classified according to nature, target teacher knowledge domain, type of education, and duration. Using the classifications as a guide, TEIs and other teacher education providers can better plan and have more-focused in-service training for mathematics teachers to enhance various aspects of mathematics teachers' competencies.

Penuel et al. (2007) examined the effects of different characteristics of professional development on teachers' knowledge and their ability to implement an inquiry science program. Found to be significant for promoting program implementation were teachers' perceptions about the coherence of their professional development experiences, incorporation of time to plan, and provision of technical support for implementing the program.

In a three-year case study of one school system's adoption and implementation of a school program using the Concerns-Based Adoption Model, Kelly and Staver (2005) found that administrative support was positive but insufficient to facilitate implementation of a new program and a more substantial change in teaching. A systematic, ongoing program of professional development is necessary to address teachers' concerns and help the school system succeed in curriculum implementation. This was earlier supported by Loucks-Horsley et al. (1998) and Russel (1998) who noted a positive influence on teaching and learning when sustained professional development focused on teaching a standards-based curriculum. Otherwise, if there is no continuing support and reinforcement after some exposure to professional development opportunities like in-service training, teachers may go back to their previous teaching practices. This could be attributed to inadequacy of training, continued resistance to change, lack of motivation before and during training, difficulties in implementation, and lack of resources such as equipment and materials (UP NISMED, 2003).

Synthesis of related literature. While a number of models have been developed to facilitate implementation of curriculum innovations in various levels of the educational system, a limited number related studies focused particularly on curriculum adaptation in mathematics teacher education. Nevertheless, related literature on educational change, curriculum innovations in mathematics, teacher education, technology, and related areas provided theoretical background for this study.

Curriculum is characterized in various contexts (Tyler, 1957; Doll,1996, Glatthorn, Boschee & Whitehead, 2006) and categorized in various forms and levels (Goodlad, 1979; Glatthorn, Boschee & Whitehead, 2006; Robitaille & Dirks, 1982; Robitaille et al., 1993). A common framework used by member and participating countries in IEA international studies involves three levels: intended curriculum, implemented curriculum and achieved curriculum (Robitaille & Dirks, 1982; Robitaille et al., 1993). These levels of the curriculum, however, are often used in the context of assessment up to the level of student achievement. Hence, a modified version of curriculum implementation (Glatthorn, Boschee & Whitehead, 2006) which characterizes curriculum levels from the perspective of curriculum implementers was used in this study to explore variations in curriculum adaptation at the institutional and at the classroom levels.

The issuance by CHED of a new memorandum on the revised policies and guidelines for the Mathematics Teacher Education Curriculum (or any higher education program) signals the implementation of a new curriculum by TEIs and HEIs in the country (CMO 11 s. 1999, CMO 30, s. 2004, CMO 52 s. 2007). The criteria for assessing implementation of a new or revised teacher education curriculum usually involves satisfying the minimum requirements in program administration of the curriculum as stipulated in the implementing policies and guidelines. TEIs usually adapt their respective institutional versions of the new curriculum after assessing their institutional readiness based on the minimum requirements set by CHED. Hence, there is a need to determine their institutional capability in terms of campus resources, accreditation status, and program compliance with the policies and standards of the revised curriculum. There is also a need to assess the readiness of the mathematics teacher educators themselves by looking into their views and practices, self-efficacy, technological pedagogical content knowledge, and related concerns on how they can successfully adapt the Mathematics Teacher Education Curriculum in the classrooms.

Different approaches could be used as bases for assessing readiness and adaptation of teacher education institutions and mathematics teacher educators in implementing the Mathematics Teacher Education Curriculum. The studies of Pedro (1996) and Peralta (2005) were based on the existing policies and guidelines on the administration of the teacher education program prior to CMO 30 s. 2004 and CMO 52 s. 2007 while the studies by Salazar (2008) and Limjap, et al. (n.d.) were already based on the latest CMO. Peralta assessed the effectiveness of the teacher education program while Salazar determined the extent of implementation of the field study courses in teacher education. The studies of Pedro and Limjap, et al. focused specifically on the Mathematics Teacher Education Curriculum. Pedro assessed the *effectiveness of the* *preservice program for mathematics teachers* of seven (7) TTIs based on DECS' policies and standards on teacher education while Limjap et al. assessed the *readiness of 10 TEIs with a mathematics education program* vis-à-vis the latest CMO as well as the Framework for Mathematics Teacher Education. Limjap et al. went into determining the mathematics teacher educators' readiness in implementing the Mathematics Teacher Education Curriculum in terms of mathematics teachers' pedagogical content knowledge and beliefs in teaching mathematics. The instruments were based on the Inquiry Mathematics and School Mathematics Traditions (Bernardo, 2002) which manifest in the mathematics classroom as constructivist and behaviorist curricular orientations as confirmed by the study of Handal (2003) and in the same context as used in the TEDS-M international study (Tatto et al., 2012). The local evaluation studies primarily used descriptive survey research methods. Quantitative and qualitative data were collected using survey questionnaires. Interviews were also used in studies by Pedro, Salazar, and Limjap et al. Classroom observations were done only by Pedro and Salazar.

CHED evaluates the compliance of state TEIs with the minimum standards for the BSEd program stipulated in CMO 30 s. 2004 and CMO 52 s. 2007 while AACUUP conducts accreditation visits of the BSEd program using AACCUP instruments based on CHED standards. This study went further by considering BSEd program compliance with CHED minimum standards as well as BSEd program accreditation by AACCUP, together with other institutional characteristics, as factors affecting the extent of curriculum adaptation by the state TEIs at the institutional level. Moreover, the study looked into selected qualities of MTEs as factors affecting their extent of curriculum adaptation at the classroom level.

Fullan (1991) identified concerns such as resources, practices, and beliefs that need to be addressed when implementing a curriculum. In the study of Sieminski (2010), an important factor in policy implementation reflects considering the teachers' prevailing work practices and views about their roles and tasks in carrying out the new policy. Similarly, Penuel et al. (2007) found significant factors in implementing an inquiry science program such as teachers' perceptions about the coherence of their professional development experiences, incorporation of time to plan, and provision of technical support for implementing the program. Likewise, Loucks-Horsely et al. (1998), Russel (1998), and Kelly and Staver (2005) asserted the need for a systematic and sustained professional development program in order to improve teaching and succeed in implementing the curriculum.

Belleza (2001) attributed successful implementation of educational innovations among member institutions of the National Council of Educational Innovators (NCEI) to visionary school administrators as well as critical and reflective teachers. Meanwhile, Ogena & Brawner (2004) found that effective practices in implementing science and mathematics curriculum in top-performing elementary and high schools in the Philippines are brought about by school leadership, and school management and structure that foster a culture and tradition of excellence through the curriculum, delivery modes, science and mathematics teachers, laboratory equipment and library facilities, assessment, and generation and management of resources. More specifically, in the study of Galido (2005), factors in the successful implementation of the mathematics curriculum in science high schools include hiring of faculty with appropriate degrees within their specialization as well as allocation for faculty and staff development. Vermeulen et al. (1996)

determined school, teacher and stakeholder factors in implementing curriculum innovations in high school mathematics, physics, chemistry, and biology.

Several studies on technology integration also revealed a number of environmental, personal, social, and curricula factors in the successful implementation of technology integration in teaching (Twigg, 2000; Chan Lin et al., 2006; O'Neil & Perez, 2003), specifically in mathematics (Kersaint et al., 2003; Mistretta, 2005; Oates (2009). In contrast, the studies of Tinio (2002) and Cajilig (2009), found that problems in ICT use and integration in public high schools are mainly due to lack or inadequate computer equipment, facilities, and resources as well as inadequate training of teachers.

From the review of related literature, no particular study on mathematics teacher education used *adoption time*, *compliance level*, and *degree of innovation* as criteria in describing extent of curriculum adaptation by institutions and by teacher educators. These criteria, however, were modified based on a study in agriculture (Marasigan, 1994) and on the Diffusion of Innovations Model by Rogers (1995). Also, no particular study dealt specifically with factors in adapting the revised BSEd-Math curriculum at the institutional and classroom levels. Hence, extent of adaptation and underlying factors at the institutional and classroom levels were derived from related variables that are associated to or influence curriculum change, policy or program implementation, effective practices, use of technology, and other innovations in mathematics, science, and related disciplines in various levels of education as well as in organizations and among individuals.

For this study a combination of qualitative and quantitative approaches was considered in exploring institutional characteristics, qualities of MTEs, and extent of curriculum adaptation at the institutional and classroom levels from the perspective of different groups of stakeholders. Extent of curriculum adaptation was characterized in terms of adoption time, compliance level, and degree of innovation in the implementation of the revised MTEC adapted by the institutions. At the classroom level, extent of curriculum adaptation by the MTEs was examined further through the use of inquiry mathematics teaching and technology integration in their mathematics classes in the BSEd-Math curriculum adapted by their respective institutions. Factors affecting curriculum adaptation at the institutional level were explored from institutional characteristics like number of campuses, SUC level, budget allocation, number of accredited programs, BSED program accreditation level, and BSEd program compliance which have not been previously investigated but assumed to have large or significant effects on extent of curriculum adaptation by the institutions. Subsequently, factors affecting curriculum adaptation at the classroom level were explored from qualities of the MTEs like views and practices in inquiry mathematics teaching, self-efficacy in teaching mathematics, and technological pedagogical content knowledge which were assumed to have large or significant effects on extent of curriculum adaptation by the MTEs in their mathematics classes.

Based on the review of literature and to the knowledge of the researcher, the effects of the foregoing institutional characteristics and MTE qualities on extent of curriculum adaptation have not been studied by anyone. Most studies on curriculum adaptation are about adapting the curriculum to children with special needs in the context of inclusive education but no study dealt with extent of curriculum adaptation as to compliance level and degree of innovation, effects of institutional characteristics like number of campuses and number of accredited programs to extent of curriculum adaptation, or effects of teacher qualities like self-efficacy and TPCK on extent of curriculum adaptation.

Conceptual Framework

A modified adaptation of the curriculum framework by Glatthorn, Boschee & 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 in analyzing the curriculum supported and adapted by each SUC-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.

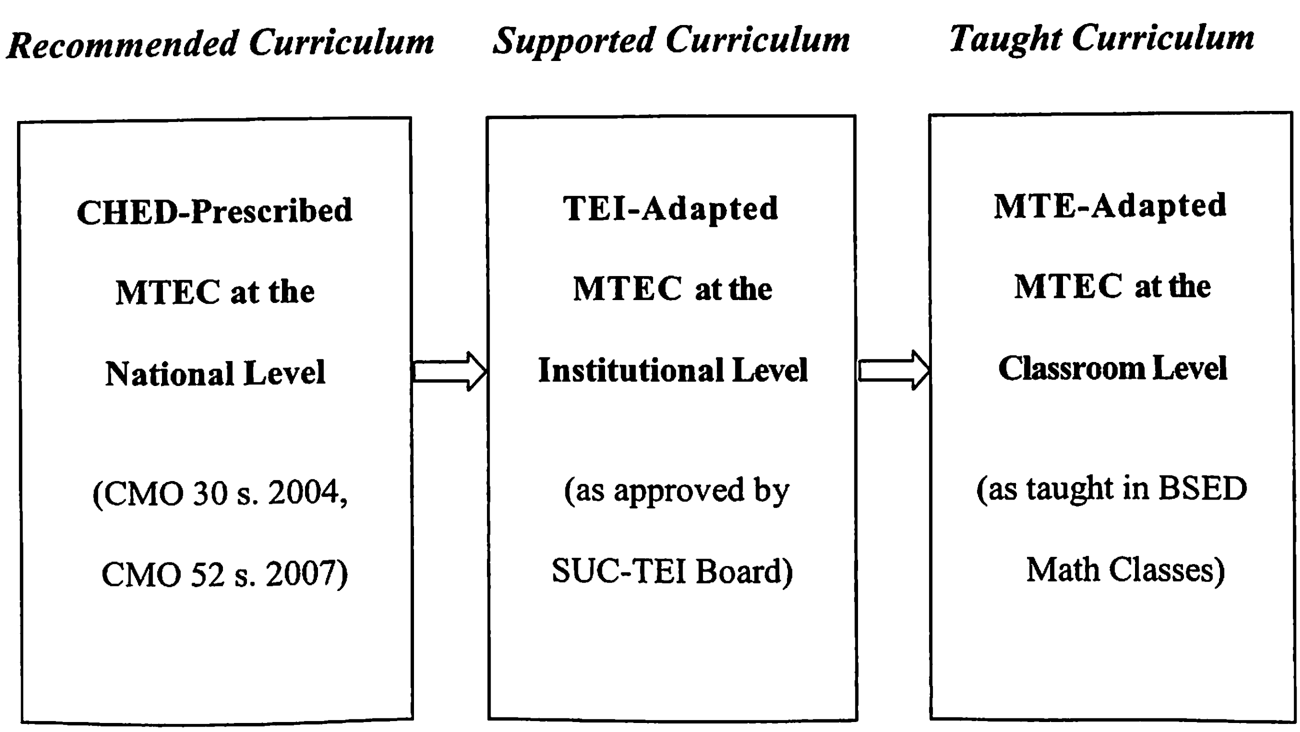

Figure 1. Levels of MTEC implementation in SUC-TEIs

Shown in Figure 2 is the conceptual framework of the study. The upper inner box on the left represents *Institutional Characteristics* of SUC-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).

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 SUC-TEI Adaptation* at the *institutional level* and the lower inner box for *Extent of MTE Adaptation* at the *classroom level.* Specifically, extent of curriculum adaptation by the MTEs is based on use of *inquiry mathematics teaching* and *technology integration* in their mathematics classes in the BSED-Math curriculum. Criteria for assessment at the institutional and classroom levels are: (a) *Adoption time*, (b) *Compliance level*, and (c) *Degree of innovation* (*made* and *used*).

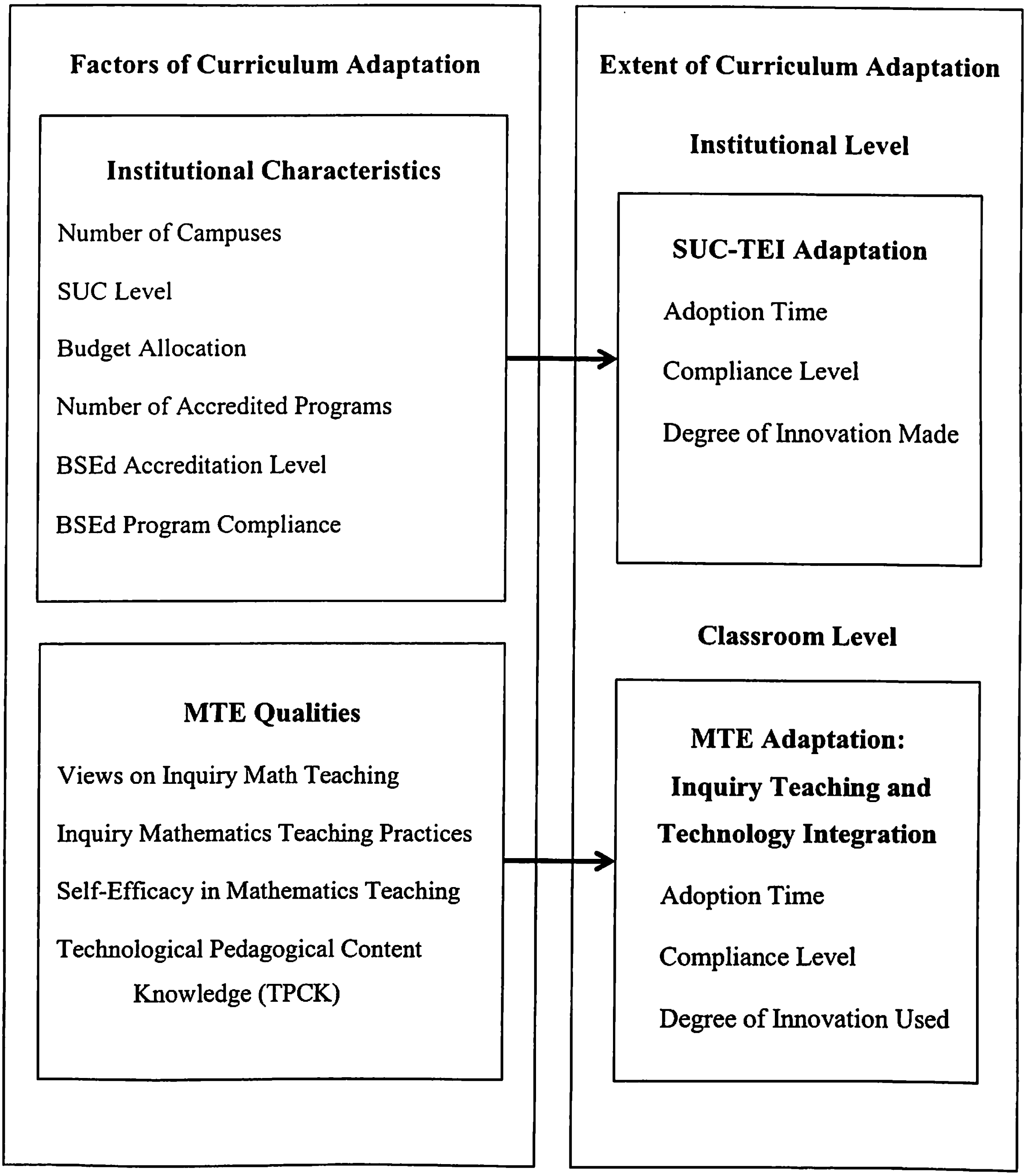

Figure 2. Conceptual Framework of Study

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

Research Hypotheses

The research hypotheses of the study are:

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

Definition of Terms

The following terms are defined as used in the study:

1. ***SUC-TEI*** refers to a teacher education institution in a state university or college in Central Luzon offering the BSEd-Math curriculum.

   1.1 ***High-performing SUC-TEI*** refers to a SUC-TEI whose graduates from the BSEd-Math curriculum consistently comprised a large number ($n > 30$) and high percentage of passers ($P > 50\%$) in the Licensure Examination for Teachers in the last five years before the study.

   1.2 ***Middle-performing SUC-TEI*** refers to a SUC-TEI whose graduates from the BSEd-Math curriculum consistently made up a small number

($n < 30$) but a high percentage ($P > 50\%$) of passers in the Licensure Examination for Teachers in the last five years before the study.

1.3 ***Low-performing SUC-TEI*** refers to a SUC-TEI whose graduates from the BSEd-Math curriculum consistently made up a small number ($n < 30$) and a small percentage ($P < 50\%$) of passers in the Licensure Examination for Teachers in the last five years before the study.

2. ***SUC-TEI*** (or ***institutional***) ***characteristics*** refers to the latest information about the SUC-TEIs such as number of campuses, SUC level, budget allocation, number of accredited programs, BSEd program accreditation level, and program administration based on the extent of compliance with CHED revised policies and standards on program administration, faculty, library, facilities, laboratory and students as per CMO 52, s. 2007.

3. ***SUC-TEI*** (or ***institutional***) ***extent of adaptation*** refers to a SUC-TEI's extent of implementation of the Mathematics Teacher Education Curriculum in terms of adoption time, compliance level, and degree of innovation based on the BSEd-Math curriculum adapted and implemented by the institution.

   3.1 ***Adoption time*** refers to promptness (very prompt to non-adoption) in adopting the MTEC based on the school year the revised BSEd-Math curriculum was implemented by a SUC-TEI.

   3.2 ***Compliance level*** (very low to very high) is based on the percentage (below 20% to 80% and above) of the number of units and course description of CHED-prescribed BSED-Math subjects offered by a SUC-TEI.

3.3 ***Degree of innovation made*** (very low to very high) is based on the number of innovations done by a SUC-TEI on the BSEd-Math subjects prescribed by CHED like increasing the number of units, adding a subject, replacing a prescribed subject by a related subject, and combining two or more subjects.

4. ***Mathematics Teacher Education Curriculum*** (*MTEC*). In general, this refers to the BSEd-Math curriculum offered by a SUC-TEI. Specifically, it refers to the mathematics subjects offered in the said curriculum prescribed by CHED, adapted by TEIs and taught by the mathematics teacher educators in the classroom.

5. ***Mathematics teacher educator*** (*MTE*) refers to a faculty member teaching mathematics subjects in the BSEd-Math curriculum.

6. ***MTE qualities*** refer to selected qualities expected of the mathematics teacher educators to be able to implement the Mathematics Teacher Education Curriculum in the mathematics classroom based on the corresponding responses in the Survey Questionnaire for Mathematics Teacher Educators.

   6.1 ***Views on inquiry mathematics teaching*** describe the MTEs' perceived emphasis of ideal mathematics teaching as indicated by their responses to the bipolar self-rating scale based on the Inquiry Mathematics and School Mathematics Traditions (Bernardo, 2002)

   6.2 ***Inquiry mathematics teaching practices*** characterize the MTEs' mathematics teaching practices as indicated by their responses to the bipolar self-rating scale based on the Inquiry Mathematics and School Mathematics Traditions (Bernardo, 2002)

6.3 ***Self-efficacy in mathematics teaching*** refers to the MTEs' level of confidence (very low to very high) in doing each task in teaching mathematics based on their responses to the Mathematics Teaching Self-Efficacy rating scales.

6.4 ***Technological pedagogical content knowledge*** (**TPCK** or **TPACK**) refers to the MTEs' indicated level of knowledge in using technology in teaching mathematics based on their responses to the items adapted from the TPACK Survey (Schmidt et al., 2009).

7. ***MTE adaptation*** refers to the extent of implementation of the Mathematics Teacher Education Curriculum by the MTEs through ***inquiry teaching*** and ***technology integration*** in the mathematics classroom in terms of ***adoption time***, ***compliance level***, and ***degree of innovation used*** based on corresponding responses in the Survey Questionnaire for Mathematics Teacher Educators.

   7.1 ***Inquiry teaching*** refers to teaching of mathematics that focuses on inquiry-based learning of students by discovery learning through exploration, collaboration, investigation, and problem solving consistent with the Inquiry Mathematics Tradition; and in contrast with the School Mathematics Tradition in which teaching of mathematics is characterized by teacher-centered instruction that focuses on learning by mastery and replication of mathematical operations, rules, and procedures (Bernardo, 2002).

7.2 ***Technology integration*** refers to the use of calculators, computer algebra systems, electronic spreadsheets, Internet, online resources, and related technologies in teaching BSEd-Math classes.

7.3 ***Adoption time*** refers to promptness (very early to non-adoption) of the MTEs in using inquiry teaching strategies and technologies in their BSEd-Math classes.

7.4 ***Compliance level*** (very low to very high) is based on the percentage (below 20% to 80% and above) of mathematics subjects taught by the MTEs in which they used inquiry teaching strategies and technologies.

7.5 ***Degree of innovation used*** (very low to very high) is based on how frequently (almost never to all the time) the MTEs used innovations in the BSEd-Math curriculum in terms of inquiry teaching strategies and technologies.

8. ***Factors of curriculum adaptation*** refer to institutional characteristics of SUC-TEIs and qualities of MTEs, and related concerns and considerations that affect the extent of adaptation of the MTEC at the institutional and classroom levels.

CHAPTER III

RESEARCH METHODOLOGY

The foci of discussion in this chapter are the methods of research as used in the study. The discussion highlights the research design, the research setting, the respondents, the instruments, and the procedures applied in the collection and analysis of data.

Research Design

A mixed-methods research design combining qualitative and quantitative approaches was used to explore variations in curriculum adaptation in mathematics teacher education at the institutional and classroom levels. The study was basically designed as a multi-site study with descriptive, comparative, and correlational perspectives; in order to describe, make comparisons, and identify factors associated to how teacher education institutions and mathematics teacher educators adapt to curriculum innovations in mathematics teacher education. Purpose-wise, the study had some features and elements of policy research.

The study had gone through the following stages: (a) preliminary survey prior to the selection of the research sites; (b) descriptive survey in all of the identified SUC-TEIs offering the BSEd-Math curriculum; and (c) follow-up qualitative study in the selected low-performing, middle-performing, and high-performing SUC-TEIs.

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. Region III was originally composed of Bataan, Bulacan, Nueva Ecija, Pampanga, Tarlac, and Zambales. It currently consists of seven provinces with the inclusion of Aurora, which used to be part of Region IV until the creation of Region IV-A and Region IV-B. 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. Seven of these SUCs have satellite and extension campuses in various locations in their respective provinces while each of the remaining five SUCs has but one campus. The Region also hosts the University of the Philippines Diliman Extension Program in Pampanga (UPDEPP) and the University of the Philippines Diliman Extension Program in Olongapo (UPDEPO). The Polytechnic University of the Philippines also has Regional Campuses in Sta. Maria, Bulacan and in Mariveles, Bataan while the Philippine State College of Aeronautics Campus at Basa Air Base is in Floridablanca, Pampanga.

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 main campus or flagship campus of the 10 identified SUC-TEIs in Central Luzon offering the BSEd-Math curriculum:

- Aurora State College of Technology (ASCOT)
  Main Campus, Baler, Aurora

- Bataan Peninsula State University (BPSU)
  Balanga Campus, Balanga City, Bataan

- Bulacan State University (BulSU)
  Main Campus, Malolos City, Bulacan

- Central Luzon State University (CLSU)
  Science City of Muñoz, Nueva Ecija

- Don Honorio Ventura Technological State University (DHVTSU)
  Main Campus, Bacolor, Pampanga

- Nueva Ecija University of Science and Technology (NEUST)
  Main Campus, Cabanatuan City, Nueva Ecija

- Pampanga Agricultural College (PAC)
  Magalang, Pampanga

- Ramon Magsaysay Technological University (RMTU)
  Main Campus, Iba, Zambales

- Tarlac College of Agriculture (TCA)
  Camiling, Tarlac

- Tarlac State University (TSU)
  Lucinda Campus, Tarlac City, Tarlac

Hence, the survey was conducted in five main campuses, three lone campuses, and two flagship campuses of the above 10 SUC-TEIs located in three provincial capital cities, two provincial capital towns, two other cities, and three municipalities in the seven provinces of Central Luzon.

Figure 3 shows the geographical location of the research sites in the seven provinces of Central Luzon.

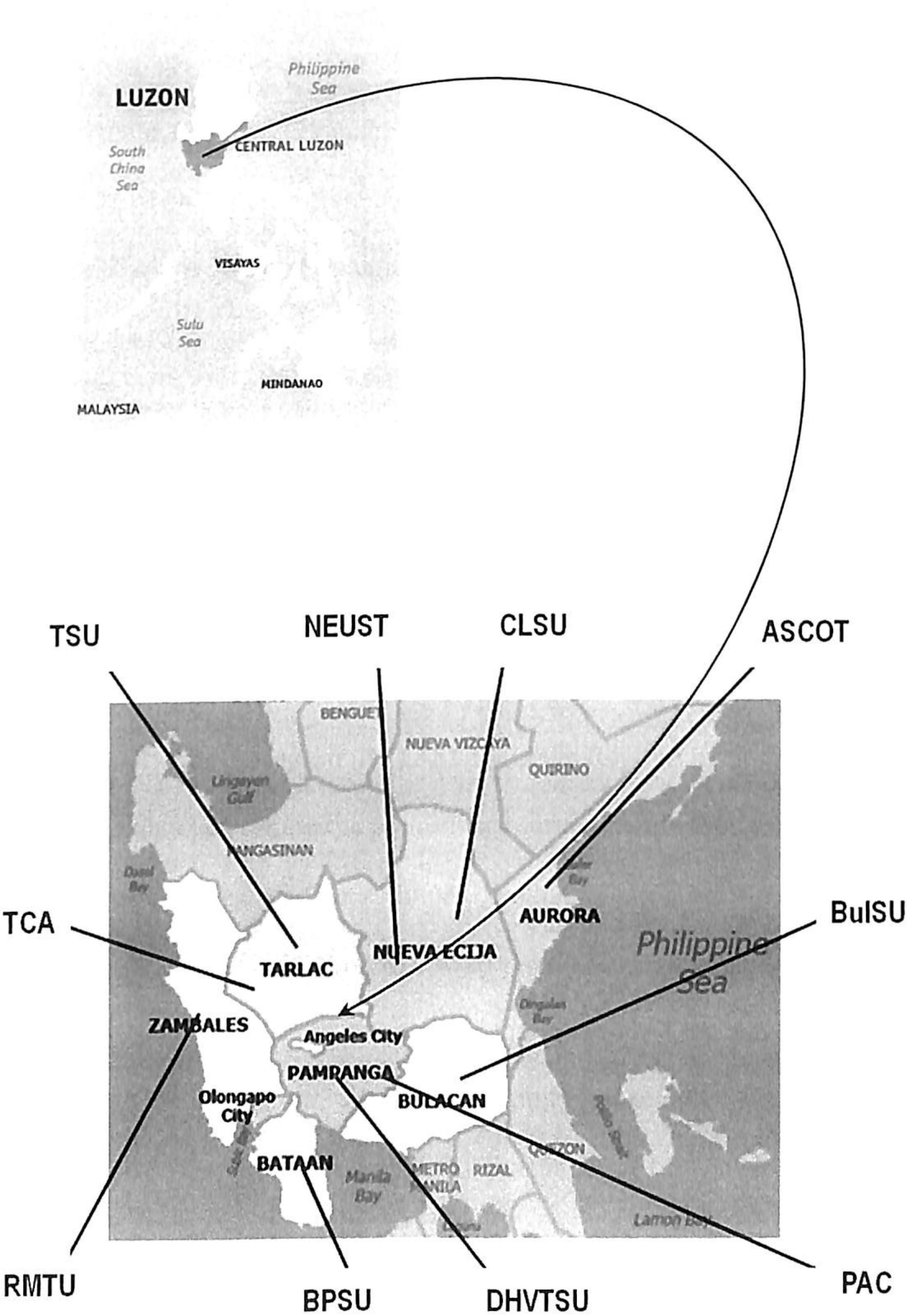

Figure 3. Location of research sites in Central Luzon

As state institutions of higher education, SUCs are governed by their respective Board of Regents/Trustees. The Board is chaired by a CHED Commissioner with the SUC President as Vice Chairman. The other members of the Board are Representatives from the Senate and Congressional Committees on Higher Education, Regional Directors (Region III) of the National Economic and Development Authority (NEDA), the Department of Science and Technology (DOST), the Department of Agriculture (DA), as well as representatives from the faculty, alumni, students and the private sector. The other officials who manage the affairs of the SUCs include the administrative staff and the designated vice presidents, campus directors, college deans, department heads, and coordinators from members of the faculty and non-teaching staff.

The Sample

Initially, the 10 (out of the 12 SUCs in the Region) institutions which offer BSEd-Math were identified during the preliminary survey before the conduct of the study. When the pre-survey data on enrollment, graduates, and licensure examinations were completed, the SUC-TEIs were then categorized according to the performance of their BSEd-Math graduates in the Licensure Examination for Teachers (LET) for the last five years prior to the study (2007-2011). The resulting categories were High-Performing SUC-TEIs with large numbers and high percentages of LET passers, Middle-Performing SUC-TEIs with small numbers but high percentages of LET passers, and Low-Performing SUC-TEI with few passers and low passing percentage. *Large number* or *small number* corresponds to having more than 40 or less than 30 LET passers, respectively, from the total number of BSEd-Math graduates. Likewise, *high percentage* or *low percentage* corresponds to having more than 50% or less than 50% LET passers, respectively, from the total number of BSEd-Math graduates.

From the seven SUC-TEIs with at least five BSED-Math graduates annually, a follow-up qualitative study was conducted in four selected SUC-TEIs (the only low-performing, 1 middle-performing, and 2 high-performing which consistently belonged to the top). The other two middle-performing SUC-TEIs had less than five BSED-Math graduates annually.

Three groups of stakeholders from the 10 SUC-TEIs served as respondents of this study. Administrators of the 10 SUC-TEIs comprised the first group of respondents. The second group consisted of mathematics teacher educators, and the third group was composed of BSEd-Math students. Table 3 shows the breakdown of the three groups of respondents from the low-performing, middle-performing, and high-performing categories of institutions.

Table 3

Distribution of Respondents as to Category of SUC-TEI Performance

Group of Respondents	SUC-TEI Category of Performance		
	Low	Middle	High
A. Descriptive survey			
Administrators	1	3	6
MTEs	5	12	20
B. Follow-up study			
Administrators	1	1	4
MTES	2	2	4
Students	8	8	16

Administrators. The 10 *administrator* respondents included four deans (of the college or institute of teacher education), four BSEd program chairpersons and two mathematics coordinators. Seven of these administrators are female (one from low-performing, two from middle-performing, and four from high-performing institutions); three are male (one from middle-performing and two from high-performing institutions. Age-wise, two are in their 50's, while four each are in their 40's and 30's. The overall mean age is 43 (35 for low-performing, 47 for middle-performing, and 38 from high-performing institutions).

In terms of academic rank, three each are full professors and associate professors; while four are assistant professors. Four administrators have undergraduate and master's degrees in mathematics education. The other six administrators are holders of undergraduate degrees in industrial education (3), science education (2), and social studies (1); four of whom also hold masters degrees in educational management, while two had masters degrees in science education and in business education, respectively. Subsequently, 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. Two have just started doctoral studies in educational management and in mathematics, respectively. Two have not yet started doctoral studies.

All the administrator respondents are licensed professional teachers with relevant training and experience in teaching, supervision, and management. Six passed the Professional Board Examination for Teachers (PBET) while three passed the LET. One passed both the PBET and the LET. As college honor graduates, three were granted civil service eligibility by virtue of Presidential Decree No. 907.

Mathematics teacher educators. 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 mathematics teacher educators from the 10 SUC-TEIs responded in the actual survey. The profile of respondent mathematics teacher educators is shown in Table 4.

Males and females are almost equal in number, except for one additional female. In the low-performing institution, two are male and three are female. In the middle-performing institutions, six are male and six are female. Ten males and 10 females come from the high-performing institutions. The ratio of single to married is approximately 2:3. As to age, about 19% are in their 20s while around 30% each are in their 30s and 40s. Five percent are in their 50s while 8% are in their 60s. On the average, they are about 39.6 years old (36 in the low-performing, 38.7 in the middle-performing, and 40 in the high-performing institutions).

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% assistant professors. The remaining 65% are instructors and lecturers. Also around 65% already have permanent positions. About 5% have temporary positions whereas 27% are on contractual basis. Around 73% are full-time faculty of the College or Institute of Education while 27% belong to other Colleges or Institutes. In terms of professional affiliation, about 70% are active members of professional associations but only 35% are members of mathematics organizations.

Table 4

Frequency Distribution of Mathematics Teacher Educator Eespondents by Selected Profile Variables (n=37)

Profile variable	Categories	Frequency	%
Gender	Male	18	48.65
	Female	19	51.35
Civil status	Single	15	40.54
	Married	21	56.76
	Widowed	1	2.70
Age	20-29	7	18.92
	30-39	12	32.43
	40-49	13	35.14
	50-59	2	5.40
	60 & above	3	8.11
Highest educational attainment	BS	14	37.84
	MA/MS	14	37.84
	EdD/PhD	9	24.32
Area of specialization	Mathematics	30	81.08
	Computer Science	1	2.70
	Engineering	4	10.81
	Physical Science	2	5.41
Eligibility*	Professional Teacher	27	72.97
	Civil Engineer	2	5.41
	CS Professional	12	32.43
Academic rank	Professor	4	10.81
	Associate Professor	6	16.22
	Assistant Professor	3	8.11
	Instructor/ Lecturer	24	64.86
Appointment status	Permanent	25	67.57
	Temporary	2	5.41
	Contractual	10	27.03
Full time teaching in education	Yes	27	72.97
	No	10	27.03
Member of professional associations	Yes	26	70.27
	No	11	29.73
Member of mathematics associations	Yes	13	35.14
	No	24	64.86

* *Four licensed teachers also passed the Career Service Professional Examination*

Of the 37 mathematics teacher educators in the sample, 13 each have 1 to 9 and 10 to 19 years, while 11 have 20 to 44 years of teaching experience. Meanwhile, 23 have been teaching mathematics in the BSEd-Math curriculum for less than 10 years, seven each for 10 to 19 and 20 to 35 years. Altogether, the teachers have an average of 15.7 years of teaching experience, 9.7 years have been for handling mathematics in the BSEd-Math curriculum. The computed standard deviations (11.4 and 9.4), however, showed a wide variation of responses for both number of years of teaching experience and years of teaching in BSEd-Math. Table 5 further shows descriptive statistics for specific indicators of training and preparation of mathematics teacher educators in the Region.

Table 5

Descriptive Statistics for Training and Preparation of Mathematics Teacher Educators

Indicators of Training and Preparation	*Min*	*Max*	*Mean*	*SD*
Number of years of teaching experience	1	44	15.73	11.37
Number of years of teaching BSEd-Math subjects	1	35	9.73	9.39
Number of math seminars & trainings attended	0	15	2.43	3.56
Number of pedagogy seminars & trainings attended	0	15	2.65	3.51
Number of technology seminars & trainings attended	0	10	2.00	2.44
Number of math seminars & trainings conducted	0	5	0.81	1.47
Number of pedagogy seminars & trainings conducted	0	5	1.14	2.72
Number of technology seminars & trainings conducted	0	5	0.68	1.97

Within the last five years prior to the survey, mathematics teacher educators from SUC-TEIs in Region III had attended an average of two seminars and trainings in mathematics and in technology, and around three in mathematics teaching. On the average, MTEs had conducted about one seminar or training in mathematics, in teaching, and in technology during the same period. The computed standard deviations revealed that responses to the number of seminars and trainings attended in mathematics, in teaching strategies, and in technology have wider variations than the responses to the corresponding number of seminars and training conducted by the mathematics teacher educators.

Only eight mathematics teacher educators indicated willingness in the last part of the survey and became respondents in the follow-up interview. Of the eleven mathematics teacher educators from four different SUC-TEIs who expressed willingness to be observed in their mathematics classes, not one was actually observed. The two mathematics teacher educators from the low-performing SUC-TEI no longer taught mathematics classes in the BSEd-Math curriculum when a new dean of their college was designated before the start of the First Semester of School Year 2012-2013. Five other mathematics teacher educators were from the two middle-performing SUC-TEIs with less than five graduates annually. The four mathematics teacher educators from a high-performing SUC-TEI were from the SUC-TEI which was not part of the top two consistently high-performing SUC-TEIs identified for the in-depth qualitative study.

Nevertheless, six administrators (2 mathematics coordinators, 2 deans with mathematics specialization, and 2 BSEd program chairpersons with science education degrees) from six SUC-TEIs who observed mathematics classes of mathematics teacher educators under their supervision agreed to share results of their classroom observations for 21 mathematics teacher educators following the prepared observation criteria.

Students. The third group of respondents consisted of 32 *BSED-Math students* selected through purposive sampling from each year level in the four SUC-TEIs representing the two *high-performing*, one *middle-performing* and one *low-performing* SUC-TEI categories. A total of 18 male (6 from low-performing, 3 from middle-performing, and 9 from high-performing institutions) and 14 female students (2 from low-performing, 5 from middle-performing, and 7 from high-performing institutions) became respondents in the follow-up interview to explore how the mathematics teacher educators adapted the BSEd-Math curriculum at the classroom level. The students have ages from 16 to 23 years old (typically 19 years old each from the low-performing, middle-performing, and high-performing institutions).

The Instruments

This study made use of survey questionnaires, interview guide, and classroom observation checklist. Other sources of data were websites and annual reports of the SUC-TEIs, pertinent documents such as board resolutions, the approved BSED-Math curriculum, sample course syllabi, and other documents related to the BSEd-Math curriculum.

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

The **Survey Questionnaire for Mathematics Teacher Educators** (Appendix E) was designed to gather data on mathematics teacher educators' profile, characteristics and extent of adaptation to the Mathematics Teacher Education Curriculum. Parts I and II consisted of five items each to measure mathematics teacher educators' 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). Descriptions along the right column for items numbered 1, 3 and 5 as well as those along the left column for items numbered 2 and 4 are competencies along IMT. Descriptions on the opposite columns are competencies along SMT (See Appendix E). To facilitate analysis, responses to the bipolar rating scales were coded to measure mathematics teacher educators' increasing levels of emphasis/characteristics of *inquiry-based mathematics teaching* (consistent with IMT) as compared to *traditional mathematics teaching* (consistent with SMT). The coding used was as follows: 1-Not at all, 2-Little, 3-Same as traditional, 4-Much, 5-Very much.

In Part III, 10 items were constructed to measure mathematics teacher educators' **Mathematics Teaching Self-Efficacy** using 5-point self-rating scales based on principles of constructing *Self-Efficacy Scales* (Bandura, 1994). 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 through email. The adapted items made use of 5-point self-rating scales on selected indicators to measure mathematics teacher educators' extent of knowledge on the use of technology in teaching mathematics from 1 (Not at all true of me) to 5 (Very true of me).

In Part V, 10 items were constructed using checklists and open-ended questions to determine mathematics teacher educators' **Extent of Adaptation** to the Mathematics Teacher Education Curriculum and related concerns about teaching mathematics subjects in the BSEd-Math curriculum. Item 1 consisted of a checklist in matrix form to determine the mathematics teacher educators' background preparation in teaching mathematics such as mathematics courses taken, seminars and trainings attended and conducted, mathematics subjects taught, and mathematics subjects willing to teach in the BSEd-Math curriculum. Items 2 to 9 sought responses about the mathematics teacher educators' **extent of adaptation** as to **adoption time, compliance level,** and **degree of innovation** in using inquiry-based teaching strategies and technology integration in teaching mathematics subjects in the BSEd-Math curriculum. The items include checklists for corresponding 5-point rating scales based on the period (start of classes to not at all) and the frequency (never to always) of use of suggested teaching-learning activities and technologies as stipulated in CMO 30 S. 2004 and in the sample course syllabi for mathematics subjects in the CHED-prescribed Mathematics Teacher Education Curriculum.

Item 10 consisted of sentence-completion type questions about mathematics teacher educators' teaching practices in their BSEd-Mathematics classes. At the end of the questionnaire, mathematics teacher educators were asked to indicate their willingness and consent to participate in a follow-up interview and classroom observation.

An **Interview Guide for Mathematics Teacher Educators** (Appendix F) was constructed to gather their responses in the follow-up interview. Open-ended questions were prepared to assess their knowledge, participation, preparation, problems, actions, interventions, suggestions and recommendations about the implementation of the revised BSEd-Math curriculum in their respective institutions and mathematics classes.

A **Survey Questionnaire for BSEd-Math Students** (Appendix G) was designed to get their perceptions on issues concerning the BSEd-Math curriculum, the teachers' characteristics and extent of adaptation of the Mathematics Teacher Education Curriculum in the mathematics classroom. Items were constructed using a combination of checklists and open-ended questions about the teachers' use of inquiry-based teaching strategies and technology integration in teaching mathematics subjects in the BSEd-Math curriculum.

A **Classroom Observation Checklist** (Appendix H) was designed as a guide for classroom observations of mathematics teacher educators in their mathematics classes. The items were based on the CHED-prescribed Mathematics Teacher Education Curriculum and suggested course syllabi. Specific indicators focused on mathematics teacher educators' use of inquiry-based teaching strategies and technology integration in their mathematics classes in the BSEd-Math curriculum. Specific indicators for the mathematics teacher educators' use of inquiry-based teaching strategies and technology integration practices were rated from 1 (Not at all) to 5 (Very much). The administrators who observed classes of mathematics teacher educators were also asked to write their overall impressions, observations and remarks about the teachers who were observed, the students, and the lessons/activities taken up in the mathematics class.

All the research instruments were content validated by three mathematics experts from the UP College of Education (two from UP NISMED and one from the UP Integrated School). They assessed the validity of the research instruments based on *correctness*, *comprehensiveness*, *clarity* and *usability* as validation criteria and using a 4-point rating scale for the said criteria from 1 (Not at all) to 4 (Very Much). Two experts, however, declined to give corresponding numerical ratings for their assessment. Only one used the suggested rating scales and came up with very high mean ratings about the research instruments: 3.75 each for the Interview Questionnaire as well as for the Survey Questionnaire and the Interview Guide for the MTEs, and 4.0 each for the Interview Questionnaire for Students and for the Classroom Observation Checklist.

In general, the validators gave positive and encouraging remarks about the research instruments. The following suggestions were given for further improvement of the research instruments:

- Ensure that the respondents know what the new curriculum is promoting or emphasizing … inquiry-based teaching.
- Align the instruments vis-à-vis the statement of the problem, definition of terms, data analysis and other essential parts of the research paper. Always keep in mind the variables that you have and how these will be measured.

- Provide checklists and choices for some items. Respondents are often too busy to answer questions especially the more difficult ones.

Finally, the research instruments were revised and tried out in two satellite campuses of a multi-campus state university in the Region during the first two weeks of March 2012. These campuses, which also offer the BSEd-Math curriculum, are located in two different municipalities, several towns away from the main campus.

Respondents to the pilot survey were the ten professors and instructors handling mathematics subjects in these two campuses. Responses to the 5-point self-rating items of the Survey Questionnaire for Mathematics Teacher Educators were coded using the corresponding scoring rubrics and subjected to reliability analysis. Cronbach alpha (α) coefficients were computed to assess the internal consistency of the responses to the rating scale items. The computed reliability indices are summarized in Table 6.

Table 6

Reliability Indices for Rating Scale Items in the Survey Questionnaire for MTEs

Rating Scales	Number of Items	Cronbach Alpha
Views on Mathematics Teaching	5	0.78
Mathematics Teaching Practices	5	0.77
Mathematics Teaching Self-Efficacy	10	0.85
Technological Pedagogical Content Knowledge	10	0.77

Based on a rule of thumb, the computed reliability coefficients indicate acceptable measure of reliability for each corresponding set of rating scales used in the Survey Questionnaire for Mathematics Teacher Educators as compared to the adapted rating scales.

The instruments were finalized after incorporating the comments and suggestions of respondents in the pilot survey. Cronbach alpha coefficients were also computed and presented with the data from the actual survey.

To establish the credibility and validity of the data obtained from the instruments and sources, triangulation techniques were also used in the conduct of the actual study. Survey and interview data from the administrators, the mathematics teacher educators, and students were verified and cross-checked together with the data obtained from observations and from documentary sources.

Data Collection Procedure

Initially, a preliminary survey was conducted to gather pre-survey data among SUCs in Region III which offer the BSEd-Math curriculum. A letter of request with the attached Pre-Survey Form was sent to each SUC President on February 15, 2012. The data on BSEd-Math graduates and LET performance in the five years (2007-2011) prior to the survey were originally intended for the selection of low-performing, middle-performing, and high-performing SUC-TEIs in Region III as research sites before the conduct of the study. But with the delayed release of said data from most of the SUCs, the actual survey was eventually conducted in all the 10 SUC-TEIs in the Region offering BSEd-Math.

Permission to conduct the study in each SUC-TEI was first requested through a letter addressed to each SUC President (Appendix A). Permission was also requested from the College Dean, the BSEd Program Coordinator, the Mathematics Coordinator, other concerned officials and mathematics teacher educators as respondents of the study.

Actual data gathering for the qualitative data and quantitative measures for the study began in March 2012 and ended in December 2012.

Collection of data from each SUC-TEI involved several phases. First, institutional profile and relevant information concerning the implementation and program administration of the BSEd-Math curriculum were gathered using interview questionnaires for administrators, site visits, relevant documents and websites of the 10 SUC-TEIs. Then, faculty profile and characteristics as well as extent of adaptation of mathematics teacher educators in BSEd-Math classes were gathered using survey questionnaires for mathematics teacher educators from the 10 SUC-TEIs.

After all the data on BSEd-Math graduates and LET performance had been collated and analyzed, six state universities were categorized as *high-performing* SUC-TEIs, three state colleges as *middle-performing* SUC-TEIs and one state university as *low-performing* SUC-TEI. Finally, the more in-depth qualitative study was conducted in four of the seven SUC-TEIs with at least five BSEd-Math graduates annually. Two SUCs consistently fell in the *high-performing* category. The other two institutions consisted of one *middle-performing*, and one *low-performing*, respectively.

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 willingness to be interviewed at the end of the survey questionnaire. Information relative to the mathematics teacher educators' extent of adaptation of the Mathematics Teacher Education Curriculum in their mathematics classes were gathered through interviews with selected BSEd-Math students from the high-performing, middle-performing and low-performing SUC-TEI categories.

Finally, other supporting data on the mathematics teacher educators' observed inquiry-based teaching practices and use of technology in mathematics classes were also gathered from administrators who expressed willingness to share their classroom observations of mathematics teacher educators in mathematics classes in the BSEd-Math curriculum. Checklists were accomplished by these supervisors inasmuch as no other mathematics teacher educators from the SUC-TEIs identified for the qualitative study expressed willingness to be observed in their BSEd-Math classes, except two mathematics teacher educators who were no longer assigned to handle BSEd-Math classes during the conduct of the qualitative phase of the study.

Copies of the mathematics teacher educators' sample course syllabi and related materials for their mathematics classes in the BSEd-Math curriculum were also requested from the prospective samples. Content analysis of these documents was done to further explore mathematics teacher educators' extent of curriculum adaptation in their mathematics classes.

Data Analysis Procedure

SUC-TEIs as study sites were considered as units of analysis for curriculum adaptation at the institutional level. For curriculum adaptation at the classroom level, units of analysis were mathematics teacher educators from the SUC-TEIs.

Institutional characteristics and MTE qualities as well as information relative to the BSEd-Math curriculum implemented in each of the 10 SUC-TEIs were tabulated and subjected to critical content analysis to facilitate description, comparison and cross-analysis among SUC-TEI categories. Content analysis and related qualitative approaches were used to analyze qualitative data from documents, observations, and responses in the open-ended questions and interviews.

Initially, responses and observation data were coded and categorized based on observed themes and patterns. Specifically, data were coded using appropriate rubrics to facilitate quantitative treatment. For views and practices in inquiry mathematics teaching, ratings from 1 to 5 were described as very low to very high emphasis on inquiry. Likewise, ratings from 1 to 5 indicated very low to very high levels of self-efficacy as well as TPCK. Corresponding ratings and specific indicators for extent of curriculum adaptation at the institutional and classroom levels are described in Tables 7 and 8.

Table 7

Scoring Rubric for SUC-TEI Extent of Curriculum Adaptation

Rating	*Adoption Time*	*School Year Implemented*
1	Non-Adoption	Not implemented
2	Very Late	2008-2009 or later
3	Late	2007-2008
4	Prompt	2006-2007
5	Very Prompt	2005-2006
Rating	*Compliance Level*	*% of Compliance with Number of Units and Description of CHED-Prescribed Courses*
1	Very low	Below 20
2	Low	20 – 39
3	Moderate	40 – 59
4	High	60 – 79
5	Very High	80 and above
Rating	*Degree of Innovation Made*	*Number of Innovations Done* in the CHED Model Curriculum*
1	Very low	No innovation
2	Low	Only 1 innovation
3	Moderate	2 innovations
4	High	3 innovations
5	Very High	More than 3 innovations

Table 8

Scoring Rubric for MTE Extent of Curriculum Adaptation

Rating	*Adoption Time*	*School Year Implemented*
1	Non-Adoption	Not at all adopted
2	Very Late	Before final term
3	Late	Before midterm
4	Early	Before preliminary term
5	Very Early	At start of the term
Rating	*Compliance Level*	*% of Subjects with Inquiry Teaching/ Technology Integration*
1	Very low	Below 20
2	Low	20 – 39
3	Moderate	40 – 59
4	High	60 – 79
5	Very High	80 and above
Rating	*Degree of Innovation Used*	*Frequency of Inquiry Teaching/ Technology Integration*
1	Very low	Almost never
2	Low	Seldom
3	Moderate	Sometimes
4	High	Often
5	Very High	All the time

Descriptive statistics such as frequency, percentage, mode, mean, standard deviation, and coefficient of variation were computed from the quantitative and coded data. Ranks and order statistics as well as graphs were also used to analyze the quantified data. Linear regression was used to analyze the effects of institutional characteristics and MTEs' qualities to extent of curriculum adaptation at the institutional and classroom levels.

For grouping purposes, ratings in the 5-point scales below 3 were considered *low* while ratings of 3 and above were considered *high* levels of observed extent of adaptation to the Mathematics Teacher Education Curriculum. Profiles of institutions and mathematics teacher educators from the low and high groups 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. Whenever appropriate, coded responses were cross-tabulated as well as corresponding phi coefficients were computed to facilitate analysis of factors drawn from qualitative data.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

This chapter presents the data and discusses the results and the findings of the quantitative- qualitative multi-site study. Data collected from the respondents, documents, and other related sources of information are summarized in tables or presented in figures to facilitate analysis and interpretation. Discussions highlight findings from content analyses of qualitative data, as well as results of statistical analyses of quantitative data.

Discussion begins with the institutional characteristics of the state teacher education institutions in Region III offering the BSEd-Math curriculum, and continues with the qualities of mathematics teacher educators handling the BSEd mathematics subjects. Discussions in the succeeding sections focus on the extent of curriculum adaptation by the SUC-TEIs at the institutional level and by the MTEs at the classroom level. Discussions highlight the perspectives of administrators, teachers, and students based on the data from the survey questionnaires, interviews, classroom observations, and available documents.

The chapter ends with a discussion on the underlying factors of curriculum adaptation at the institutional and classroom levels and a presentation of the reconceptualized framework. Results of quantitative data analysis and findings from analyses of the qualitative data were combined in the hope that a holistic interpretation would lead to a more comprehensive understanding of the factors of curriculum adaptation at different levels and from a variety of perspectives.

Institutional Characteristics of State TEIs in Central Luzon

The profile of the 10 SUC-TEIs in Central Luzon offering the BSEd-Math curriculum is summarized in Table 9.

Table 9

Profile of the Ten State Institutions Offering BSEd-Math in Central Luzon (N=10)

Indicator	Category	Frequency
Number of campuses	Only 1	3
	2 - 4	3
	5 - 7	3
	10 and above	1
CHED-DBM SUC leveling classification	Level II	2
	Level III-A	7
	Level IV	1
Average annual budget allocation (in million PhP)	Below 50	1
	50 - 99	4
	100 - 149	2
	150 - 199	2
	200 and above	1
Number of accredited programs (by AACCUP)	0 – 9	2
	10 – 19	3
	20 – 29	3
	30 and above	2

Number of campuses. Of the three state colleges in the Region, two have only one campus while one has three campuses. Among the seven state universities, only the Central Luzon State University (CLSU) is located in one campus. The other six are multi-campus state universities with campuses ranging from 2 to 10. Five of the seven state universities offer the BSEd-Math curriculum in the main campus as well as in other satellite campuses, but the other two (of the seven) do not have a College of Education in the main campus. Instead, the BSEd-Math program is offered in the other campuses with flagship programs in teacher education.

SUC level. In 2007, results of the SUCs leveling by the Department of Budget and Management (DBM) and the Commission on Higher Education (CHED) revealed the classifications of the state universities and colleges in the country. Typically, seven (70%) of the SUC-TEIs in Central Luzon are Level III-A institutions. Two are Level II institutions. Only one is a Level IV institution.

Budget allocation. With regard to budget allocation, the Level IV institution has the highest appropriation from the national government with PhP 268.873 million in 2011 and PhP 278.231 million in 2012. Four SUCs received average annual allocations from 100 to 200 million pesos while four other SUCs received an average of 50 to 100 million pesos in 2011 and 2012. One of the two Level II SUCs, however, received only about 30 million pesos annual budget allocation for the same period.

Number of accredited programs. As of December 2012, the Accrediting Agency of Chartered Colleges and Universities in the Philippines (AACCUP) has already accredited degree programs (graduate as well as undergraduate courses) in the main and satellite campuses of nine of the 10 SUC-TEIs in Region III. Two state universities already have 32 and 30 accredited programs, respectively. One state college and two state universities have 20 to 29 accredited programs whereas two other state universities and another state college have 10 to 19 accredited programs, respectively. As expected, the two Level II institutions classified by DBM and CHED have the smallest number of programs accredited by AACCUP. The Level II state university has only seven accredited programs while the other Level II state college has just started preparing for program accreditation.

BSEd program compliance. In CMO 52 s. 2007, the CHED set minimum requirements for the program administration of the *Revised Curriculum for Undergraduate Teacher Education Programs* (CMO 30 s. 2004). The following sections describe the levels of compliance of SUC-TEIs in Region III in each corresponding component as indicated by administrators from their respective institutions.

Administration. Not surprisingly, all of the 10 SUC-TEIs in the Region indicated 100% compliance in the Administration component of the CHED policies and guidelines. All the Deans of the College or Institute of Teacher Education have doctorate degrees (Ed.D. or Ph.D.) in Education and related disciplines. They are all licensed professional teachers with adequate teaching experience in basic education.

Faculty. With regard to the Faculty component, nine of the 10 SUC-TEIs indicated 80-100% compliance. One SUC-TEI, where some faculty have no master's degrees and no teaching license, indicated 60-79% compliance.

Library. For the Library component, eight of the ten institutions have 80-100% compliance. With limited books and references especially in mathematics, two institutions indicated 60-79% compliance.

Physical facilities. In terms of physical facilities and equipment, nine indicated 80-100% compliance and one 60-79% compliance. The SUC-TEIs typically indicated high compliance with physical facilities except adequate computer equipment and software for preparation and presentation of audio-visual instructional materials.

Laboratory school / cooperating schools. Eight SUC-TEIs indicated 80-100% whereas two SUC-TEIs indicated 60-79% compliance with the minimum requirements for laboratory school or cooperating schools. Each of the 10 SUC-TEIs, except one, actually maintains a laboratory school managed by the TEI faculty. One SUC-TEI with no laboratory school and another with a laboratory school had signed a memorandum with cooperating schools based on proximity to the said SUC-TEIs.

Students. As to student admission and retention, nine institutions indicated 80-100% compliance while one indicated 60-79% compliance with the minimum requirements set by CHED. All the 10 SUCs have entrance examinations for incoming freshmen students. However, two SUCs administer non-standardized admission tests designed by the said institutions. Incidentally, high-performing institutions generally implement stricter retention policies for students beginning to take professional education and specialization courses.

Hence, the SUC-TEIs typically have very high compliance with the above-mentioned components, with only one or two institutions indicating a high level of compliance. Incidentally, the SUC-TEIs already have the CHED COPC for their respective BSEd programs. Hence, institutional compliance may imply that the institutions in the Region are typically ready to adapt the Revised BSEd curriculum in their respective colleges or institutes of teacher education, especially that the SUC-TEIs have already subjected their BSEd programs for accreditation by the AACCUP.

BSED program accreditation and performance. Current accreditation levels and performance ratings of the BSEd-Math specialization programs of the ten SUC-TEIs from the Region are summarized in Table 10.

Table 10

BSEd-Mathematics Program Performance Profile of State Institutions in Central Luzon (N=10)

Indicator	Category	Frequency
BSEd program accreditation (AACCUP)	Candidate	1
	Level II	2
	Level III	7
Number of BSEd-Math graduates (2007-2011)	Below 10	1
	10 - 29	1
	30 - 49	3
	50 - 69	2
	70 - 89	1
	90 - 109	1
	110 and above	1
Number of BSEd-Math LET passers (2007-2011)	Below 10	1
	10 - 29	3
	30 - 49	3
	50 - 69	2
	70 and above	1
LET passing rate (in %) of BSEd-Math Graduates (2007-2011)	Below 50	1
	50 - 59	2
	60 - 69	3
	70 - 79	2
	90 and above	2

As of December 2012, AACCUP has already accredited the BSEd programs of nine SUC-TEIs in Region III. Seven colleges or institutes of teacher education of five state universities and two state colleges in the Region have already attained Level III Re-accredited status for their respective BSEd programs. Meanwhile, two other state universities with Level II Accredited status are preparing for Level III accreditation of their BSEd Programs. One state college has yet to undergo initial accreditation of its BSEd program.

As regards performance in the Licensure Examination for Teachers (LET), three of the seven universities with stricter retention policies consistently obtained the top three positions among SUC-TEIs in the Region with the highest number of BSEd-Math graduates who also passed the LET during the same period (with 51 to 115 LET passers). Three other state universities had 33 to 45 BSEd-Math LET passers. In contrast, the number of LET passers among BSEd-Math graduates in the three state colleges and in one state university during the period are all below 30.

In terms of percentage of LET passers among BSEd-Math graduates, nine of the 10 SUC-TEIs consistently obtained more than the national passing percentage during the 5-year period. For the same 5-year period, two state universities both registered 91.67% while two state colleges had 78.79% and 75% LET passers, respectively. Three other state universities had 67.02%, 66.18%, and 65.34% while a state university and a state college had 58.62% and 57.89% LET passers, respectively. One state university only had 29.63% LET passers out of its less than 30 BSEd-Math graduates.

The 10 SUC-TEIs were finally grouped based on number (n) and percentage (P) of LET passers out of their corresponding total number of BSEd-Math graduates. Three SUC-TEI categories were identified with their specified descriptions as follows:

- High-performing ($n > 30$; $P > 50\%$)
- Middle-performing ($n < 30$; $P > 50\%$)
- Low-performing ($n < 30$; $P < 50\%$)

(All are required more than 50% passing rate for examinees in the last five years.)

Six universities are considered "high-performing" for having more than 30 LET passers and more than 50% passing percentage from their respective BSEd-Math graduates. The three state colleges, with less than 30 LET passers but with more than 50% passing percentage out of their respective BSEd-Math graduates, are considered "middle-performing". Sadly, one state university in Region III is considered low-performing for consistently having the lowest number of less than 30 LET passers and the lowest passing percentage below 50% out of its 54 BSEd-Math graduates for the 5-year period.

Qualities of Mathematics Teacher Educators

This section explores selected qualities of the mathematics teacher educators respondents such as views on inquiry mathematics teaching, inquiry mathematics teaching practices, self-efficacy in teaching mathematics, and technological pedagogical content knowledge in mathematics. These qualities have been considered in this study as primary variables associated to curriculum adaptation by mathematics teacher educators at the classroom level.

Views on inquiry mathematics teaching. Views on mathematics teaching reflect the beliefs held by mathematics teacher educators on how mathematics should be taught in the classroom. Responses of the mathematics teacher educators on the bipolar self-rating scale for views on mathematics teaching are summarized in Table 11.

Each number indicates the frequency of responses as to how the MTEs view each pair of competencies should be given emphasis in teaching mathematics. Numbers closest to either the left- or right-side description represent the frequency of those who indicated which of the paired competencies should be emphasized in teaching. Numbers in the middle column indicate the frequency of those who indicated that both competencies should be equally emphasized.

Table 11

Frequency Distribution of Mathematics Teacher Educators as to Responses on How Students Should Be Taught in a Mathematics Class (n=37)

	Student Learning Competency in Traditional Teaching	Frequency					Student Learning Competency in Inquiry Teaching
		A	B	C	D	E	
1.	Memorize properties and relations of mathematical objects	1	4	16	15	1	Explore meaning and applications of mathematical concepts
2.	State precise definitions, axioms and theorems	_	10	19	7	1	Verify conjectures, propositions and arguments
3.	Perform manual operations with speed and accuracy	3	10	21	3	_	Use appropriate mathematical tools and devices
4.	Master mathematical skills through drill exercises	2	5	24	6	_	Generate their own solutions of real-world problems
5.	Work individually on mathematical tasks	1	12	17	7	_	Work together as a team on group projects

Note: Descriptions of paired competencies were rearranged to facilitate data analysis. See Part I of Appendix E for comparison. Total frequency on each row is n=37. Corresponding ratings are described as follows:

A – Emphasis only on traditional (not at all inquiry-based)
B – More emphasis on traditional than inquiry
C – Equal emphasis on traditional and inquiry
D – More emphasis on inquiry than traditional
E – Emphasis only on inquiry (very much inquiry-based)

In all the items, the maximum frequencies along the middle column indicate that most mathematics teacher educators held the view that equal emphasis should be given to both traditional and inquiry mathematics teaching. Frequencies near the extremes for each individual item also reveal that mathematics teacher educators have eclectic views on mathematics teaching. In item number 1, while 16 mathematics teacher educators put equal emphasis on both competencies and one each put sole emphasis on the opposing competencies, 15 mathematics teacher educators put more emphasis on *exploring meaning and applications of mathematical concepts* as compared to four mathematics teacher educators who put more emphasis on *memorizing properties and relations of mathematical objects.* But in the other four items, for those who put sole or more emphasis on either of the paired competencies, more mathematics teacher educators favored competencies along traditional mathematics teaching over inquiry mathematics teaching.

Overall, a total of 41 teachers put more emphasis on traditional teaching than inquiry-oriented teaching whereas 38 MTEs put more emphasis on inquiry teaching than traditional teaching. For those who indicated that only one of the paired competencies should be emphasized, seven indicated emphasis on four competencies of traditional teaching while only two indicated emphasis on two competencies of inquiry teaching.

Ratings for each corresponding item were then coded (from 1 for "Not at all" to 5 for "Very much" inquiry-based) and descriptive statistics such as mean and standard deviation were computed to come up with equivalent measures for views on inquiry-based mathematics teaching. Table 12 shows the computed measures for each corresponding reconstructed views on how students should be taught using inquiry-based mathematics teaching.

With 1 as the lowest and 5 as the highest rating, individual and overall mean ratings are close to 3. This indicates that, on the average, mathematics teacher educators from SUC-TEIs in Region III hold moderate views toward inquiry-based teaching, with highest rating for *exploring meaning and applications of math concepts* and lowest rating for *using appropriate math tools and devices.* Equivalently, the computed means confirm that mathematics teacher educators typically put equal emphasis to inquiry-based and traditional teaching of mathematics. Variations of responses to each of the five items are quite similar, as revealed by the values of the standard deviations ranging from 0.72 to 0.81.

Table 12

Means and Standard Deviations of Mathematics Teacher Educators' Self-Ratings on Inquiry-Based Views about Mathematics Teaching (n=37)

Student Learning Competency in Inquiry-Based Teaching	*Mean*	*SD*
Exploring meaning and applications of math concepts	3.30	0.81
Verifying conjectures, propositions and arguments	2.97	0.76
Using appropriate math tools and devices	2.65	0.75
Generating own solutions to practical problems	2.92	0.72
Working together on group activities and projects	2.81	0.78
Overall Rating for Views on Mathematics Teaching	2.90	0.51

Responses to the sentence-completion item of the survey questionnaire on the teacher respondents' philosophy in teaching also reveal insights about the MTEs' views in mathematics teaching. Serendipitously, analysis of the teacher respondents' statements of philosophy in teaching mathematics showed indications that the MTEs are guided by the following categories of mathematics teaching orientations:

- inquiry-based (15 or 41%)
- traditional (4 or 11%)
- not explicitly stated as traditional or inquiry-based (18 or 49%)

The following philosophies by mathematics teacher educators, quite similar to familiar teaching-learning theories, characterize inquiry-based teaching that are consistent with the Inquiry Mathematics Tradition (Bernardo, 2002):

- "The student is the focal point of instruction in mathematics."
- "Mathematics is learned by doing, computing, solving and understanding."
- "Math is easy, fun and interesting provided that activities are appropriate."
- "Foundation is always provided but students are free to explore possibilities."
- "For students to be able to understand the world through their skills in math."

The use of technology in teaching is another manifestation of inquiry-based teaching philosophies as one respondent from a middle-performing institution said, *"Understand basic principles and solve problems using available teaching technologies."* From a high-performing institution, another teacher wrote: *"Uplift instruction by using modern technology."*

On the other hand, the following responses characterized by teacher-directed instruction, rote memorization, drill, and mastery of skills are examples of traditional mathematics teaching philosophies consistent with the School Mathematics Tradition (Bernardo, 2002) :

- "Mathematics is a skill, not a talent."
- "The more problems you encountered, the more you learned."
- "Start with the simplest task and gradually shift to more complex."
- "Master the concepts of mathematics and you can take care of all the rest."

Non-responses and other statements by mathematics teacher educators, however, cannot be identified clearly as inquiry-based or traditional mathematics teaching philosophies. Some responses are familiar quotations which could be considered under traditional or inquiry-teaching. For example, "*You fail not because you plan to fail but because you failed to plan.*" indicates the importance of planning which is needed in traditional as well as inquiry-based teaching. "*The greatness of a man is not measured by the number of successes he earns, but by the number of times he rises from his fall.*" indicates dealing with mistakes or misconceptions, but the manner of making the correction or dealing with the misconception could be traditional or inquiry-based depending on the approach used by the teacher.

The teaching philosophies of the MTEs manifest inquiry-based as well as traditional teaching orientations, validating the indicated eclectic views of teaching mathematics similar to the findings of previous studies (Limjap et al., n.d.; Handal, 2003; Villena, 2004). These may imply that the mathematics teacher educators have some degree of readiness to adapt inquiry-based teaching in their BSEd-Math classes.

Asked whether they consider themselves to be traditional or innovative mathematics teachers, six MTEs responded that they are both traditional and innovative. One teacher claimed to be innovative, while another admitted to being more traditional. Incidentally, the MTEs were described by the student respondents as typically more innovative than traditional compared to the students' high school teachers. These responses provide some hints about the teacher educators' teaching practices in their mathematics classes.

Inquiry mathematics teaching practices. Teaching practices of mathematics teacher educators were also examined using bipolar self-rating scales (similar to Table 11). Responses of mathematics teacher educators to the bipolar self-rating scales for mathematics teaching practices are summarized in Table 13.

Table 13

Frequency Distribution of Mathematics Teacher Educators as to Mathematics Teaching Practices (n=37)

		Frequency					
	Traditional Teaching Practice	A	B	C	D	E	Inquiry Teaching Practice
1.	Present mathematics lessons in a structured and detailed manner	2	8	18	9	_	Allow longer discussions to facilitate students' inquiry
2.	Address immediately mistakes and learning difficulties of students	1	7	23	6	_	Consider students' explanations and preferences
3.	Give students many exercises for them to master important skills	3	17	13	4	_	Let students formulate and solve their own mathematics problems
4.	Make sure that students follow instructions and procedures	1	11	16	9	_	Provide opportunity for students to discover concepts
5.	Demonstrate quick solutions to mathematics problems	_	9	22	5	1	Use a wide variety of mathematics problems and tasks

Note: Total frequency on each row is n=37. Corresponding ratings are described as follows:

A – Completely traditional (not at all inquiry-based)

B – More traditional than inquiry-based

C – Both traditional and inquiry-based

D – More inquiry-based than traditional

E – Very much inquiry-based

Each number indicates how many mathematics teacher educator respondents are practicing each pair of contrasting competencies in teaching mathematics. The numbers closest to either the left or right-side descriptions indicate the corresponding frequency of those who indicated practicing the competency. Numbers in the middle column indicate the frequency of those who practice both the left and the right competencies.

In all the items, the highest frequencies along the middle column indicate that the most frequently practiced teaching competency characterize both the traditional and inquiry mathematics teaching. In four out of the five items, seven respondents indicated teaching practices characterized solely by traditional teaching. Only one item indicated a practice characterizing inquiry teaching. Meanwhile, a total of 52 marked practices characterizing traditional teaching more than inquiry teaching, whereas 31 indicated practices characterizing inquiry teaching more than traditional teaching.

Subsequently, ratings for the corresponding mathematics teaching practices were coded (from 1 for "Not at all" to 5 for "Very much" characterized by inquiry) to draw the means and standard deviations for inquiry-based mathematics teaching practices as shown in Table 14. In the 1 to 5 rating scale, individual and overall mean ratings are all very close to 3, indicating that mathematics teacher educators practice only to moderate level inquiry-based teaching, except in *letting students formulate and solve their own problems* which falls a little bit closer to a low mean rating. The computed means confirm that practices of the mathematics teacher educators almost equally characterize traditional and inquiry teaching. Variations of responses to each of the five items are also quite homogeneous with standard deviations ranging from 0.68 to 0.81.

Table 14

Means and Standard Deviations Indicating Mathematics Teacher Educators' Frequency of Inquiry-Based Teaching Practices (n=37)

Inquiry-Based Teaching Practice	*Mean*	*SD*
Allowing longer discussions to facilitate students' inquiry	2.92	0.83
Considering students' explanations and preferences	2.92	0.68
Letting students formulate and solve their own problems	2.49	0.80
Encouraging students to explore and learn by discovery	2.89	0.81
Providing a wide variety of problems and tasks	2.95	0.70
Overall Rating for Mathematics Teaching Practices	2.83	0.57

Responses to the sentence completion item of the survey questionnaire concerning the teacher respondents' *management of mathematics classes despite limited resources* also show indications of inquiry-based and traditional teaching practices. Seventeen (or 46%) indicated inquiry-based actions, six (16%) cited use of inquiry-based and traditional activities, three (8%) mentioned traditional activities, and 11 (30%) are silent about their actions.

Making use of alternative and innovative teaching-learning activities is often associated with inquiry-based teaching as indicated by responses like *"using alternative methods and strategies"*, *"presenting and discussing a wide variety of problems"*, and *"introducing other strategies to let the students participate"*. Use of available, local, alternative, or resources as well as integration of technology by mathematics teacher educators could also be considered part of inquiry-based teaching as indicated in the following responses:

- "integrating and using local materials available in the school"
- "maximizing the use of available resources"
- "providing alternative resources"
- "making use of available technology"
- "being resourceful, flexible and creative"

Inquiry-based teaching can also be gleaned from the following responses that focused on the use of cooperative and collaborative learning activities: "working together", "through class discussion, group work and collaboration", and "encouraging to work as a team in exchanging ideas, successes and failures".

On the other hand, responses like "providing enough examples and exercises" and "explaining the lessons to the best of my knowledge and ability" are typical indications of traditional teaching. Some reported actions taken by mathematics teacher educators reflect a combination of inquiry-based and traditional teaching-learning activities like: "giving seatwork and assigning projects", "classroom discussions, board work and by giving exercises to my students", "through lecture and research", and "using the traditional method and cooperative learning".

Suggested teaching-learning activities included in the course syllabi for mathematics subjects in the BSEd-Math curriculum also provide some hints about the teaching practices of the MTEs in their mathematics classes. Combinations of traditional and inquiry-based activities are listed in the mathematics course syllabi from the three categories of institutions. The 18 listed activities are: lecture-discussion, demonstration, reporting, recitation, drill and exercise, seatwork, boardwork, research, project, problem solving, brainstorming, group discussion, discovery, simulation, multimedia presentation, experiential learning, cooperative learning, and interactive learning. Seventeen (94%) of the 18 listed activities are mentioned in the high-performing institutions while 16 (89%) are listed in the middle-performing institution. Only 11 (61%) are included in the low-performing institution.

Moreover, various course requirements listed in the BSEd mathematics course syllabi also reveal the MTEs' eclectic teaching practices, implied by the combinations of traditional and alternative assessment tools used in both traditional and inquiry-based teaching. The 12 listed requirements are: term examination, long test, quiz, exercise, assignment, problem set, attendance, oral participation/recitation special project, oral and written report, seatwork, and research work. All 12 (100%) are mentioned in the high-performing institution, 11 (92%) in the middle-performing institution, and 10 (83%) in the low-performing institution. While each institution has its own uniform grading system for mathematics subjects in the BSED-Math curriculum, one high-performing institution makes use of a common transmutation table in the grading system but weights for specific components depend on the course requirements and academic freedom of mathematics teacher educators.

The use of the above-mentioned requirements are further supported by the MTEs' responses to the open-ended question concerning *assessment of student learning* in their mathematics classes. Analysis of responses revealed that 25 (68%) use a combination of traditional and alternative assessment while 12 (32%) use traditional assessment tools.

The traditional assessment tools mentioned include "paper and pencil test", "exercises, quizzes and long examinations", "tests to check mastery and to what extent the teaching-learning process have been efficient and effective".

Meanwhile, the following responses indicated the use of both traditional assessment as well as alternative forms of assessment:

- "test and non-test"
- "tests, available materials and technology"
- "examinations, board work and homework"
- "both performance-based and product-based assessment"
- "paper and pencil test, recitation, group activity and more"
- "through tests, investigation and discovery from the students"
- "quizzes, exercises and direct inquiry about the solution of a problem"
- "frequent boardwork exercises and oral presentation of their work solutions"

The respondents from the three categories of institutions most typically used combinations of traditional and alternative forms of assessment to assess student learning in their mathematics classes. One reason for the eclectic use of traditional and alternative forms of assessment is mentioned by one mathematics teacher educator who wrote: *"I use varied forms of assessment. I make sure that assessment is balanced."*

Nevertheless, the above-mentioned tools showed some indications of authentic and alternative assessment for inquiry-based learning outcomes. These assessment tools are actually the focus of *Assessment 2*, a separate subject included in the list of professional education courses in the revised MTEC.

Therefore, the foregoing manifestations of the MTEs' teaching practices are consistent with their indicated eclectic views on mathematics teaching, providing support to the findings of Limjap et al. (n.d.) and Villena (2004) that mathematics teachers' beliefs and practices fell midway between traditional and inquiry teaching. The results also confirm the findings of Handal (2003) on the existence of constructivist and behaviorist curricular orientations in the teachers' beliefs and practices in teaching mathematics. These also provide hints about the teacher educators' readiness to adapt the suggested inquiry-based teaching strategies in the revised BSEd-Math curriculum.

Self-efficacy in teaching mathematics. Another quality of mathematics teacher educators considered to be essential in implementing the BSEd-Math curriculum in the classroom is self-efficacy in teaching mathematics. On a scale of 1 to 5, the mathematics teacher educators were asked to indicate how confidently they can do each of the indicated teaching tasks (See Appendix E, Part III). Items 1 to 5 represent traditional mathematics teaching competencies while items 6 to 10 represent inquiry mathematics teaching competencies.

Table 15 shows the computed means and standard deviations of responses to the 10 items along 5-point self-rating scales. Mathematics teacher educators registered the highest average rating for the task *conduct periodic tests to monitor student's mastery of competencies* and lowest in the task *answer very difficult questions about lessons in math.* The average ratings in all items ranged from 3.43 to 4.22. These indicate that, on the average, mathematics teacher educators are generally very confident that they can do each teaching task effectively.

Overall, therefore, mathematics teacher educators from the ten SUC-TEIs have a high-level of self-efficacy in both traditional and inquiry-based mathematics teaching as indicated by their average ratings in the individual items as well as in the composite items of the self-efficacy rating scales. Hence, these show another indication that the MTEs are ready to adapt to the tasks required of them in implementing the BSEd-Math curriculum, whether using traditional or inquiry teaching approaches. The results were somewhat expected because of their expressed eclectic views and practices in teaching. However, these seem contrary to the findings of Limjap et al. (n.d.) that the MTEs had low levels of self-confidence in teaching and facilitating learning in the new mathematics courses inasmuch as their study was conducted during the initial implementation of the revised curriculum.

Table 15

Means and Standard Deviations of Mathematics Teacher Educators' Self-Efficacy Ratings in Teaching Mathematics (n = 37)

Mathematics Teaching Competency	*Mean*	*SD*
1. Deliver lectures on highly advanced topics in math	3.59	0.83
2. Help students master complicated math operations	3.86	0.71
3. Quickly demonstrate long solutions to math problems	3.84	0.83
4. Answer very difficult questions about lessons in math	3.43	1.01
5. Conduct periodic tests to monitor student's mastery of competencies	4.22	0.82
6. Share historical background or updates about lessons in math	3.76	0.86
7. Develop students' conjecturing, proving and reasoning skills	3.78	0.71
8. Manage class discussions involving small or large groups of students	3.92	0.83
9. Pose math problems involving practical real-life situations	4.03	0.83
10. Provide variety of activities that cater to students' multiple intelligences	3.81	0.88
Overall Rating for Self-Efficacy in Teaching Mathematics	3.82	0.64

Technological pedagogical content knowledge. Considered essential in technology integration in the implementation of the Revised BSEd-Math curriculum at the classroom level is *technological pedagogical content knowledge* (TPCK or TPACK), the knowledge on the use of technology in teaching mathematics. On a scale of 1 to 5, the teacher respondents were asked to rate the extent of their knowledge on each of the corresponding ten 5-point self-rating items adapted from the TPACK Survey (Appendix E, Part IV).

Ratings for each corresponding item were coded (from 1 for "Not at all" to 5 for "Very true of me"). The computed means and standard deviations for the corresponding items of the TPCK questionnaire are summarized in Table 16. The average ratings obtained from the corresponding items indicate the mathematics teacher educators' extent of knowledge in teaching mathematics through graphing calculators, computer algebra systems and ICT.

Table 16

Means and Standard Deviations of Mathematics Teacher Educators' Self-Ratings for Technological Pedagogical Content Knowledge (n=37)

TPCK Indicator	*Mean*	*SD*
I choose technologies that enhance my teaching approaches	3.78	0.85
I choose technologies that enhance my students' learning	3.70	0.85
I think critically about how to use technology in my classroom	3.76	0.83
I adapt the use of technologies to different teaching activities	3.70	1.02
I use technology for understanding and doing math	3.73	0.84
I am able to teach lessons that appropriately combine math, technologies and teaching approaches	3.70	0.85
I am able to select technologies to use in my classroom that enhance what I teach, how I teach and what students learn	3.65	0.92
I use strategies that combine content, technologies and teaching approaches in my classroom	3.70	0.97
I am able to help others about effective integration of technology in teaching math	3.65	0.92
I easily cope with changing technologies in teaching math	3.54	0.96
Overall Rating for Technological Pedagogical Content Knowledge in Mathematics	3.69	0.79

The computed average ratings in the individual and combined items of the TPCK questionnaire are all between 3.5 and 3.8 with standard deviations close to 1. Hence, the results indicate that the mathematics teacher educators from the ten state teacher education institutions in Central Luzon typically consider themselves knowledgeable ($M = 3.69$, $SD = 0.79$) about content, pedagogy and technology considerations in integrating technology in teaching mathematics. This is supported by the findings of Koh et al. (2014), as well as by the responses in the interviews with BSEd-Math students and by the observations of the supervisors that the MTEs who integrated technology in mathematics classes had mastery of the lesson and demonstrated high level of TPCK in integrating the use of computer software related to the lessons.

The instructional media specified by the MTEs in their course syllabi also provide insights about their knowledge of technologies used in teaching mathematics classes in the BSEd-Math curriculum. A total of 14 different instructional media were listed in the course syllabi from the four institutions. These are: chalk/board, whiteboard/marker, visual aids, manipulatives, calculator, computer with software, multimedia projector, lecture notes/handouts, modules, workbook/worksheets, activity sheets, multimedia presentation, computer-based lectures, and e-learning resources. Twelve (86%) of the 14 listed instructional media were mentioned in both the middle- and high-performing institutions. Correspondingly, only seven (50%) of them were mentioned in the low-performing institution. Combinations of traditional and state-of-the-art instructional materials, facilities, equipment, and related resources were included in the plan of activities for mathematics subjects in the BSEd-Math curriculum of the three categories of institutions.

Extent of Curriculum Adaptation by the State TEIs

This section describes the extent to which the state institutions have adapted and implemented the revised BSEd-Math curriculum in their respective colleges or institutes of teacher education. In response to CMO 30 s. 2004 and CMO 52 s. 2007, all the 10 SUC-TEIs in Central Luzon have already implemented the revised curriculum. Based on available data from the respondents and related documentary sources, however, these institutions adopted the revised curriculum at different times and came up with various institutional adaptations of the curriculum.

While CHED set minimum requirements for the implementation of the revised undergraduate curriculum for BSEd-Mathematics, variations can be observed in the curriculum adapted by each of the 10 SUC-TEIs in Region III. Initial analysis of the BSEd-Math curriculum adapted by these state institutions revealed that they all met the minimum required units for general education (71), professional education (51), and specialization (60) in the BSEd Model Curriculum recommended by CHED. None of the 10 SUC-TEIs adopted the CHED Model strictly with a total of 174 units. The stacked bar graph in Figure 4 shows the comparative breakdown of the total number of units in the BSEd-Math curriculum adapted by each of the 10 SUC-TEIs in Region III.

For professional education, five institutions offer 54 units while two institutions each offer 57 and 60 units, respectively. One institution offers up to 63 units in professional education. Meanwhile for mathematics specialization, four institutions each offer the minimum 60 units while two institutions each offer 62 units and 63 units, respectively. One institution offers 64 units while another institution offers 65 units of mathematics specialization subjects.

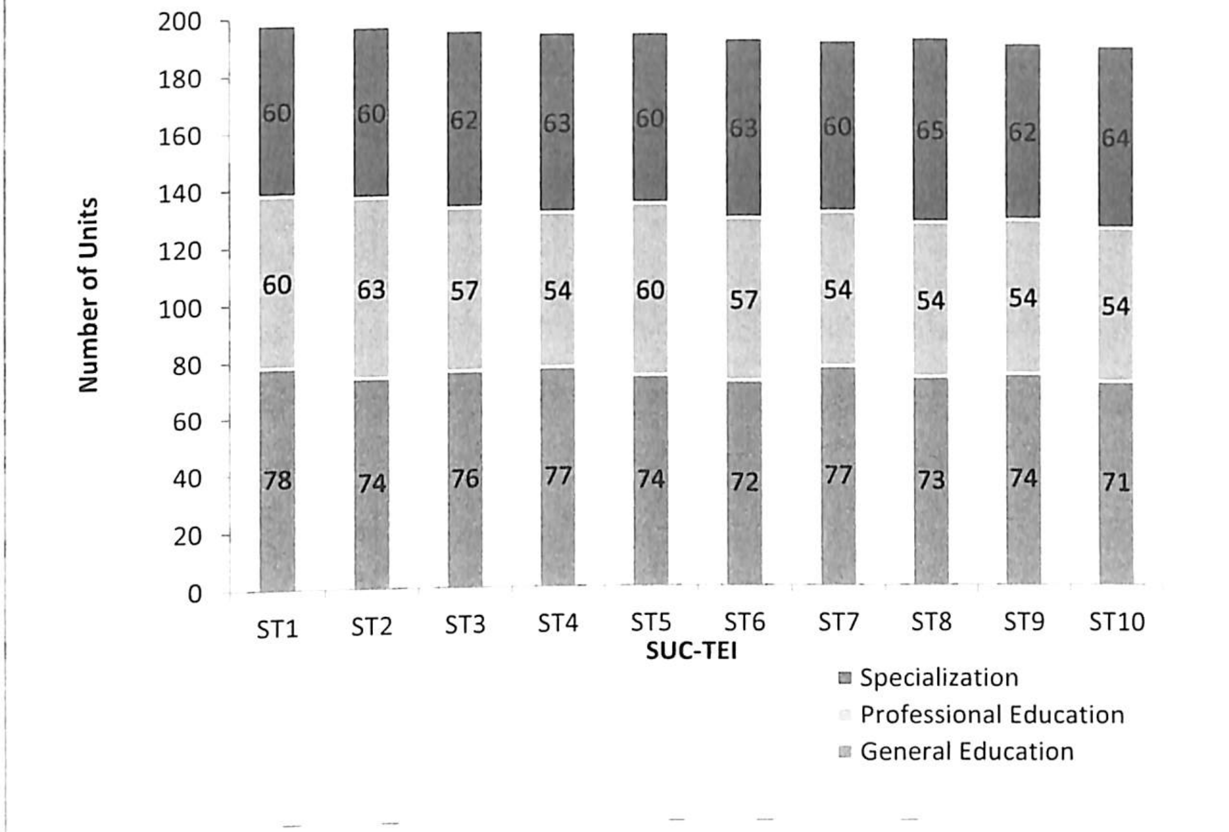

Figure 4. Breakdown of the total number of units in the BSEd-Math curriculum adapted by the ten state teacher education institutions in Region III

On the average, the typical curriculum adapted by these institutions comprises about 75 units in general education, 57 units in professional education, and 62 units in mathematics specialization. Hence, the typical BSEd-Math curriculum of these state institutions has additional 11 units or 17% increase in general education, 6 units or 12% increase in professional education, and 2 units or 3% increase in mathematics specialization as compared to the three corresponding areas of the CHED Model Curriculum. Table 17 shows the variations in the semestral offering of mathematics subjects in the BSEd-Math curriculum adapted by the 10 state TEIs.

Table 17

Variations in the Offering of Mathematics Subjects in the BSEd-Math Curriculum Adapted by State Institutions in Central Luzon

Mathematics Subject	Curriculum Year/Term Offered*								
	NO**	11	12	21	22	23	31	32	41
Fundamentals of Math	4	6							
Contemporary Math	3		7						
Basic Math	7	3							
College Algebra	6	1	3						
Advanced Algebra		1		7	2				
Trigonometry		2	1	5	2				
History of Math		2	2	4	1		1		
Plane Geometry	2		3	3	2				
Analytic Geometry				1	5	1	3		
Solid Geometry	3			2	4		1		
Calculus I					1		7	2	
Probability				1	2		6	1	
Linear Algebra					1	1	5	2	1
Elementary Statistics				2	3		4	1	
Calculus II							1	7	2
Number Theory				1	1		1	4	3
Math Investigation & Modeling	3				1			4	2
Problem Solving in Math	1			1	2		2	3	1
Advanced Statistics	2				1		3	3	1
Abstract Algebra							1	2	7
Action Research in Math Education	1							3	6
Technology in Math	2						1	2	5
Modern Geometry	3				1			2	4
Instrumentation in Math	2				1		3	1	3
Business Math/Math of Investment	6			1	1		2		
Differential Equations	7							1	2
Calculus III	8								2
Plane & Solid Geometry	8			2					
Spherical Trigonometry	8				1				1
Set Theory	8						1	1	
Strategies in Teaching Math	8							1	1
Practical Math	9				1				
Thesis Writing	9								1

* *e.g. 11 means 1st Year, 1st Semester*

** *Not Offered*

As shown in Table 17, the state TEIs typically complied with the offering all the prescribed mathematics courses in the revised curriculum as indicated by the corresponding modal frequencies, except for some subjects in the old curriculum not offered by most of the institutions. Based on the highest number of institutions which offer each mathematics subject in any semester, the typical semestral offering of mathematics subjects in the BSEd-Math curriculum adapted by the 10 SUC-TEIs in Region III can be summarized as follows:

Year	***First Semester***	***Second Semester***
First	Fundamentals of Math (6)	Contemporary Math (7) Plane Geometry (3) *
Second	Advanced Algebra (7) Trigonometry (5) History of Math (4) Plane Geometry (3) *	Analytic Geometry (5) Solid Geometry (4)
Third	Calculus I (7) Probability (6) Linear Algebra (5) Elementary Statistics (4) Advanced Statistics (3) ** Instrumentation in Math (3) ***	Calculus II (7) Number Theory (4) Math Investigation & Modeling (4) Problem Solving in Math (3) Advanced Statistics (3) **
Fourth	Abstract Algebra (7) Action Research in Math (6) Technology in Math (5) Modern Geometry (4) Instrumentation in Math (3) ***	

Note: Numbers in parentheses represent number of institutions.
, **, and * represent highest frequency occurring in two semesters*

Sequence of mathematics subjects generally reflects consideration of the pre-requisite and co-requisite subjects, except during the first semester of third year.

Advanced Statistics appears to be offered by three institutions together with the pre-requisite subjects (Elementary Statistics and Probability). A review of the BSEd-Math curriculum of the 10 institutions, however, revealed that Advanced Statistics is offered by all institutions only after Probability and Elementary Statistics have been offered in previous semesters.

The minimum number of mathematics subjects is offered by the SUC-TEIs during the first and second semesters of first year. The subjects offered during these two semesters include the two general education subjects in the CHED Model except in four institutions where College Algebra and Basic Mathematics are offered instead. Meanwhile, the maximum number of mathematics subjects is offered during the first semester of third year.

The mathematics subjects with the highest corresponding frequencies have been offered most consistently during the indicated semesters. Seven institutions each have been most consistent in offering Contemporary Mathematics, Advanced Algebra, Calculus I, Calculus II, and Abstract Algebra during the indicated semesters followed by six institutions which offer Fundamentals of Mathematics, Probability and Action Research.

On the other hand, the mathematics subjects with the lowest frequencies are those with the widest variation in semestral offering. This means that more institutions have not offered these subjects during the same semester, but in other semesters. Widest variation is observed in the offering of Problem Solving in Mathematics, Plane Geometry, Advanced Statistics, and Instrumentation in Mathematics as well as History of

Mathematics, Solid Geometry, Elementary Statistics, Number Theory, and Mathematical Investigation and Modeling.

Not reflected in the list, however, are the mathematics subjects excluded in the CHED Model Curriculum but offered by some middle-performing and high-performing institutions, another variation in the BSEd-Math curriculum adapted by the SUC-TEIs in the Region. These are Practical Mathematics, Thesis Writing, Set Theory, Spherical Trigonometry, Strategies in Teaching Mathematics, Calculus III, Differential Equations, Business Mathematics, and Mathematics of Investment. These are mathematics courses included in the previous curriculum as well as in other program offerings like engineering and business courses.

Extent of curriculum adaptation by each SUC-TEI was assessed using the following criteria:

1. *Adoption time* – based on the year of implementation of the revised BSEd-Math curriculum (beginning School Year 2004-2005)
2. *Compliance level* – based on the number of units and description of mathematics subjects in the general education and specialization subjects in the SUC-TEI adapted BSEd-Math curriculum as compared to the CHED model curriculum
3. *Degree of innovations made* – based on the number of innovations made in the adapted curriculum like additional number of units, additional number of mathematics subjects, replacing a prescribed subject with another related subject, or combining two or more subjects in one subject

Table 18 shows the frequency distributions of state TEIs in Central Luzon by extent of curriculum adaptation as to adoption time, compliance level, and degree of innovation made.

Table 18

Frequency Distribution of State Institutions in Central Luzon with Respect to Extent of Adaptation of the Revised BSEd-Math Curriculum (N=10)

Extent of Adaptation	Category (Rating)	Frequency
Adoption Time	Very prompt (5)	4
	Prompt (4)	3
	Late (3)	3
Compliance Level	Very high (5)	3
	High (4)	4
	Moderate (3)	3
Degree of Innovation	High (4)	5
	Moderate (3)	3
	Low (2)	1
	Very low (1)	1

Adoption time. The Commission on Higher Education strongly encouraged state as well as local institutions and other higher education institutions "to strictly adhere" to the provisions of CMO 30, s. 2004. Hence, nationwide implementation of the revised curriculum for BSEd-Math and all other undergraduate teacher education programs took effect beginning SY 2005-2006. Among the 10 SUC-TEIs in Region III included in this study, however, only four institutions (three high-performing state universities and one middle-performing state college) were very prompt in implementing the revised curriculum during the first year of implementation. The following School Year 2006-

2007, three institutions (one high-performing state university and two middle-performing state colleges) also began implementing the revised curriculum. Finally by School Year 2007-2008, all the 10 state teacher education institutions have already implemented the revised curriculum when the three remaining institutions (two high-performing state universities and the low-performing state university) also began implementing the revised curriculum, two years after the initial year of implementation.

Using the equivalent scores from the scoring rubric, the mean rating for time of adoption is 4.10 with a standard deviation of 0.90. Hence, state teacher education institutions in Region III were generally prompt in adopting the Revised BSEd-Math curriculum and can be described as *early adopters*, with the exception of three institutions which can be considered as falling under the category of *late majority* (Rogers, 1995).

As persons in charge of BSEd program administration and curriculum supervision, responses of the administrators about the actions of their respective institutions in implementing CMO 30, s. 2004 reveal interesting insights about the adoption of the revised curriculum by the SUC-TEIs. From the reported dates of activities, high-performing and middle-performing SUC-TEIs were typically more prompt in complying with the CHED memorandum compared to the low-performing institution which began implementing the revised curriculum two years after the prescribed initial year of implementation. An explanation for the delayed implementation of the Revised BSEd curriculum in the low-performing institution could be the peculiar but isolated *frequent change in the designated Dean of the College of Education* (referring to the six deans in the last five years).

Seven specific actions and activities from review up to the board approval of the revised curriculum were carried out in high-performing and middle-performing SUC-TEIs as compared to six in the low-performing SUC-TEI. Commonly practiced activities were mentioned except for finalization of subjects in the high-performing institution, and preliminary meeting in the middle-performing institution.

Seven different persons and groups were involved in the BSEd-Math curriculum-related activities from review up to implementation in the high-performing and middle performing institutions compared to six in the low-performing institution. Peculiar to the high-performing institution is the involvement of the Mathematics Coordinator and Curriculum Committee as compared to participation of the Department Chairman, the Curriculum Coordinator, and Academic Council in the middle-performing institution and of the Director of Instruction and Vice President for Academics in the low-performing institution.

As primary agents of curriculum implementation, the mathematics teacher educators are also key informants about curriculum adaptation in the SUC-TEIs. Their responses validated what the administrators mentioned in the interviews. Eight mathematics teacher educators who indicated willingness in the last part of the survey questionnaire became respondents in the follow-up interview using the prepared interview guide (Appendix F). Four MTEs came from high performing institutions (HT1, HT2, HT3, and HT4), two from the middle-performing institution (MT1 and MT2), and two from the low performing institution (LT1 and LT2).

Asked what they knew about the revised policies and standards for the BSEd-Math curriculum and other undergraduate teacher education programs, all the eight MTEs said they are aware and have some knowledge about the implementation of the revised BSEd-Math curriculum. They also cited how they were able to know about the implementation of the Revised BSEd-Math Curriculum. They said they learned about the revision of the Curriculum through: (a) their official function and assignment (HT3, MT1, MT2), (b) information dissemination drive in the College (LT1, LT2), (c) meetings about the implementation of CMO 30, s. 2004 (HT1, HT2), and (d) a subject in the graduate school (HT4).

The MTEs were also asked in what ways they have participated in the implementation of the above-mentioned policies in their institution. All eight MTEs said they handled some mathematics courses in BSEd-Math. Three have been members of the committee for the revision of the BSEd-Math curriculum. Two related their participation in the monitoring of syllabi and classes of mathematics teachers. One has been involved in the conduct of review classes for mathematics majors. Overall, responses of the MTEs supported the typical adoption of the revised curriculum by the institutions as evidenced by their indicated awareness, knowledge, and participation in various activities and concerns related to the BSEd-Math curriculum implementation.

Compliance level. Strict adherence to the policies and standards is expected from the SUC-TEIs in the implementation of the Revised BSEd-Math curriculum. However, content analysis of the board-approved BSEd-Math curriculum adapted by the 10 SUC-TEIs, revealed that only three high-performing state institutions in the Region have very high level of compliance in both minimum number of units and description of mathematics subjects in the general education and specialization components of the CHED model curriculum. Four institutions (two high-performing and two middle-performing) have a high level of compliance while three others (one high-performing, one middle-performing and the only low-performing) have a moderate level of compliance.

Although all the 10 SUC-TEIs complied with the minimum number of units in mathematics for general education and specialization, three institutions (one high-performing, one-middle-performing, and the only low-performing one) used descriptive titles and course descriptions from the old BSEd curriculum for the two mathematics subjects in general education. Two high-performing and two middle-performing institutions complied with the descriptions of mathematics subjects in general education but not in all major subjects. Only three high-performing institutions strictly complied with the descriptions of all the 20 major subjects in mathematics.

Based on the scoring rubric, the TEI-adapted BSEd-Math curricula obtained an overall mean rating of 4.0 with a standard deviation of 0.80. Therefore, SUC-TEIs in the Region generally have a high level of compliance with the CHED model curriculum for BSEd-Math.

Monitoring institutional compliance with policies and standards is another important role of the administrators. Asked how they monitor the implementation of the revised BSEd-Math curriculum in their schools, typical practices mentioned by the administrators are: (a) preparation and revision of course syllabi using the suggested course content and objectives, (b) assessment of student learning, and (c) retention policy to maintain quality of majors and graduates. One administrator replied: *"Faculty members revise their syllabi based on the new/revised mathematics curriculum"*. In addition, *"Faculty members are required to submit midterm and final examinations based on the TOS* [table of specifications] *and syllabi."*

In the case of one high-performing SUC-TEI, there are two sections of BSEd-Math in the first and second year levels, but the sections are merged into one by the third and fourth year levels because the students failing in the major subjects are usually advised to change their major. According to the Dean, *"One section is easier to monitor. Teachers handling the major subjects can easily assess the performance of their students."* A response from one middle-performing SUC-TEI was: *"Selective retention policy is observed. Students who do not meet grade requirements are advised to shift course or change major."*

Incidentally, critical quality assurance practices in curriculum implementation like monitoring and observation of classes as well as coordination with CHED and external linkages were also mentioned by administrators from high-performing and middle-performing SUC-TEIs but not by those from the low-performing SUC-TEI.

A closer look at these practices would imply that extent of curriculum adaptation by the SUC-TEIs can also be analyzed in terms of *input*, *process*, *output*, or *context* considerations in implementing the revised curriculum. Course syllabi content and objectives often serve as input to the process of monitoring and observation of classes. Assessment of learning is also essential in the process of monitoring the progress of MTEC implementation. The output in terms of quality of majors and graduates may also be improved through the institution's retention policy as basis for evaluating how much the revised curriculum has been implemented. Coordination with CHED and other linkages provides a way for keeping abreast of current updates on policies and practices in implementing the curriculum in the proper context.

Moreover, the administrators mentioned review and revision of the BSEd-Math curriculum as the typical intervention done by the institutions for effective implementation of the BSEd-Math curriculum. Another common intervention done by the 10 SUC-TEIs is preparing the faculty by *"sending them to seminars and trainings"*. Except for the low-performing institution, *"monitoring and observation of classes"* as well as *"strict admission policy for qualified majors in mathematics"* are also important measures taken by the SUC-TEIs for effective implementation of the revised curriculum. As mentioned in one high-performing institution, *"use, follow the CMO provisions on program administration"*. These are all indications how the institutions tried to comply with the policies, standards, and requirements of the revised curriculum.

All the eight mathematics teacher educators interviewed indicated awareness and knowledge of the revised curriculum. Five of the eight teachers mentioned that the revised curriculum was based on CMO 30, s. 2004. Two others related the increase in the number of specialization subjects while one teacher said their institution modified the title, description, and content of some courses.

The MTEs were also asked about the preparations done by their institution to help them prepare for the implementation of the revised BSED-Math curriculum. The teacher respondents mentioned the following:

- consultation and planning meetings (HT2, HT3, MT1, MT2)
- discussions about the CMO and the National Competency-Based Teacher Standards (HT3, MT1, MT2)

- seminars and trainings (HT2, MT2)
- vertical articulation in advanced studies (HT1)
- visit to other institutions (MT2), and information dissemination drive (LT2)

As regards what specific professional development activities they have attended or engaged in to prepare them for teaching mathematics subjects in the revised BSEd-Math curriculum, two have enrolled in graduate courses. Five attended seminars, training, or workshops. One simply browsed the Internet. These preparations and activities according to them, "made the teaching-learning process more interesting and challenging at the same time" (HT1), "provided more insights about the what and how of math teaching" (MT1), and were "very helpful in many ways" (MT2).

A number of responses also emerged when the student respondents were asked to describe the BSED-Math curriculum being offered by their respective institutions. The responses, however, could be grouped into two major categories. Twenty-two (22 or 69%) of the 32 students gave descriptions that fall under a well-adapted BSEd-Math curriculum while 10 (31%) of the students described a curriculum that needs improvement.

Typically, the BSEd-Math curriculum was described by a majority of the students as well-planned, organized, properly sequenced from the basics to the more complex, and evenly distributed in a comprehensive way. Subjects are integrated with each other and almost all have pre-requisite. The subjects are properly selected and are appropriate for each year level. The following are some of the responses from the students who gave positive descriptions of their BSEd-Math curriculum:

- "The curriculum increases the level of math literacy among students."

- "It really helps me to develop my skills and competencies... to think logically and critically."
- "It can accommodate the needs of the students ... in order to be successful in their career".

On the other hand, responses from the other students concerning course content, duration, schedule, and alignment of subjects described a BSEd-Math curriculum that needs improvement:

- "There are a lot of math subjects being offered in such a limited time."
- "Subjects are not so organized since we encountered difficulties when it comes to schedule and problems with regard to course description."
- "When you look at the majors, you can see that some subjects can be combined as one. They make major subjects take too long."

The curriculum encompasses all the planned and directed learning experiences to attain the goals of the school (Tyler, 1957). Hence, it is not surprising that students from the high-performing and middle-performing institutions more frequently mentioned descriptions of a well-adapted BSED-Math curriculum, an indication of compliance by the said institutions. In contrast, students from the low-performing institution are equally divided in their descriptions of the BSEd-Math curriculum adapted by their institution. Half of them described a well-adapted curriculum, while the other half said their curriculum needs improvement.

Degree of innovation made. Various innovations had been observed about the mathematics subjects in the BSEd-Math curriculum offered by the 10 SUC-TEIs.

Innovations in the adapted curriculum include the following actions with their corresponding frequencies (*f*):

- increasing the number of units of a mathematics subject ($f = 8$)
- adding a mathematics subject to the required mathematics subjects ($f = 6$)
- replacing a suggested mathematics subject by another mathematics subject with equivalent number of units ($f = 5$)
- combining two or more required mathematics subjects in one subject ($f = 3$)

The most typical innovation in the BSEd-Math curriculum by SUC-TEIs in the region is done by increasing the number of units of the prescribed 3-unit mathematics subjects in order to accommodate the inclusion of the indicated enrichment topics or activities not covered in the suggested course syllabi. Subjects which increased in number of units in some SUC-TEIs include:

- Analytic Geometry (4 or 5 units; 3D coordinates, solid analytic geometry)
- Calculus II (4 or 5 units; infinite sequences, series, and convergence)
- Calculus I (5 units; inverse functions, other transcendental functions)
- Trigonometry (5 units; spherical trigonometry)
- Elementary Statistics (4 units; laboratory)

Following closely are innovations done by adding a mathematics subject and replacing a prescribed mathematics subject with another mathematics subject. The following mathematics subjects were added, or replaced suggested mathematics subjects, in the CHED Model BSEd-Math curriculum:

- Basic Mathematics (in place of Fundamentals of Mathematics)
- College Algebra (in place of Contemporary Mathematics)

- Basic Statistics (additional general education subject)
- Elementary Set Theory (additional major subject)
- Calculus III (additional major subject)
- Business Mathematics/Mathematics of Investment (additional major subject)
- Practical Mathematics (in place of Mathematical Modeling/additional major)
- Differential Equations (in place of Mathematical Modeling/additional major)
- Spherical Trigonometry (in place of Modern Geometry)
- Methods and Strategies in Teaching Mathematics (in place of Instrumentation in Mathematics)
- Thesis Writing (in place of Action Research in Mathematics)

Many of the above subjects used to be part of the old BSEd-Math curriculum. Some are usually included in the list of required subjects for engineering and technology, business management, and other related courses.

Combining mathematics subjects in the CHED Model with other subjects or topics has been done in three SUC-TEIs which resulted in offering the following subjects.

- Plane and Solid Geometry (5 units)
- Statistics with Computer Application (4 units)
- Trends, History and Philosophy of Mathematics Education (3 units)
- Instrumentation and Curriculum Design in Mathematics (3 units)

Using the equivalent scores from the scoring rubric, the mean rating for degree of innovation based on the number of alterations done with the prescribed subjects is 3.20 with a standard deviation of 1.0. This may imply that state teacher education institutions in Central Luzon generally demonstrate a moderate degree of innovation in the adapted

BSEd-Math curriculum. Exceptions are two institutions, one which strictly adhered to the CHED model curriculum and another which modified the title and description of one mathematics subject from *Fundamentals of Mathematics* to *Basic Mathematics*.

Various adaptations of the CHED model curriculum are further revealed by the course description, objectives, and outline of topics covered in mathematics subjects included in the BSEd-Math curriculum adapted by selected institutions in the three SUC-TEI categories. In the low-performing institution, course descriptions of specialization subjects were adopted from the CHED model for the Revised BSEd-Math curriculum but general education mathematics subjects were based on the old BSEd-Math curriculum.

In the middle-performing institution, general education mathematics subjects were enhanced based on the CHED model curriculum by increasing the number of units to 4 units each and including 3 units of *Plane Trigonometry* in general education. Three units each of *Spherical Trigonometry* and *Calculus 3* were also included in the list of specialization subjects. Four units each of *Statistics with Computer Application* and Calculus 2 as well as the revised title *Instrumentation and Curriculum Design in Mathematics* are additional enhancements of mathematics specialization subjects in the CHED model curriculum.

The two high-performing institutions adopted the mathematics general education subjects. One institution added 5 units of *College Algebra* and 3 units of *Basic Statistics*, increased the number of units of 4 subjects (Analytic Geometry, Trigonometry, Calculus 1 and Calculus 2) to 5 units each, and added 3 units each of *Mathematics of Investment* and *Differential Equations*. The other institution adopted all specialization subjects from the CHED model curriculum and also added *Differential Equations*. But the two institutions strictly adopted, simplified or enhanced the course description of the mathematics subjects.

General and specific course objectives in the three SUC-TEI categories fall under the cognitive, affective and psychomotor domains. Objectives vary from low-level to higher-order skills and competencies but were expressed more comprehensively in the high-performing institutions. Values are well integrated in the middle-performing and high-performing institutions but rarely mentioned in the low-performing institution.

The adapted course content of mathematics subjects also varies in the three SUC-TEI categories. Usually, an outline of topics is strictly adopted in the new mathematics subjects not included in the old BSEd-Math curriculum but often altered by rearranging, simplifying, expanding, or enriching with related topics for mathematics subjects in the old curriculum.

In the low-performing institution, an outline of content is adopted, simplified, or enriched by adding other related topics. In the middle-performing institution, content in all mathematics subjects are adopted but enriched with related topics. In the high-performing institutions, an outline of content is adopted, rearranged, simplified, expanded or enriched with related topics.

The administrators also mentioned some innovations done by their institutions in the implementation of the revised BSEd-Math curriculum. In one high-performing institution, *"major subjects were reviewed by mathematics teachers from the College of Science, a service college where they belong"*. Likewise, the Institute of Education of a middle-performing institution also *"asked the assistance of mathematics experts such as the BS Math and Engineering faculty members from the other institutes"* of the institution. Even in the low-performing institution, *"mathematics faculty members from other colleges of the university were involved in the curriculum review"*. These manifest how the SUC-TEIs adapted by innovating the BSEd-Math curriculum through the participation and involvement of mathematics experts and faculty members from other colleges or institutes. Complementation and pooling of faculty and resources is somewhat expected especially with the increase in the number and units as well as coverage of mathematics subjects in the revised curriculum. The MTEs also indicated their participation and involvement in innovating the BSEd-Math curriculum adapted by their respective institutions. They supported the increase in the number of units of specialization courses as well as the modification in the title, description, and content of some courses.

The foregoing discussions, therefore, have shown variations in the extent of curriculum adaptation among the state teacher education institutions in Central Luzon. The findings were supported by the pre-survey data and by the responses in the interviews and questionnaires, and were verified through content analyses of available documents such as copies of the Board-approved BSEd-Math curriculum adapted by the institutions, course syllabi, and other relevant sources.

Extent of Curriculum Adaptation by the MTEs

For effective implementation of the revised curriculum, mathematics teacher educators have to adapt themselves to the BSEd-Math curriculum implementation especially at the classroom level. Specifically, they need to demonstrate adoption, compliance, and innovation when they handle the mathematics classes in the Revised BSEd-Math curriculum adapted by their respective institutions.

Variations in the adaptation of the revised curriculum by the MTEs in their classrooms are somehow expected, as manifested by the responses of the teachers themselves, their students, and administrators as well as in the course syllabi and related documents. Essentially, the MTEs should have prepared themselves to teach the prescribed mathematics subjects in the revised curriculum through enrollment in mathematics courses, attendance in seminars and conferences, conduct of trainings and workshops, or actual handling of related subjects. These may indicate their initial adaptation to the implementation of the BSEd-Math curriculum in their respective institutions.

The teacher respondents were asked to check as many rows and columns for the corresponding mathematics subjects that they enrolled and passed, attended or conducted training, taught already, or are willing to be taught in the BSEd-Math curriculum (Appendix E, Part V). Table 19 shows a summary of the preparation and training of the 37 mathematics teacher educators in teaching each mathematics subject. Each row or column total need not be equal to 37 since the responses in the corresponding rows and columns are not mutually exclusive. Row totals could range from 0 to 185 while column totals could be up to 888. Hence, the row and column totals are excluded in the summary table. None of the mathematics subjects listed was taken by all the 37 teacher respondents. However, as expected, mathematics subjects enrolled and passed by more than half of the mathematics teacher educators are those included in the old BSEd-Math curriculum. Subjects enrolled by fewer mathematics teacher educators are the new subjects in the Revised BSEd-Math curriculum such as Fundamentals of Mathematics, Contemporary Mathematics, Modern Geometry, Advanced Statistics, History of

Mathematics, Technology in Mathematics, Instrumentation in Mathematics, Problem Solving, Mathematics Investigation and Modeling, and Action Research in Mathematics.

Table 19

Frequency Distribution of Mathematics Teacher Educators Who Took the Specific Courses in the BSEd-Math Curriculum (n=37)

Mathematics Subjects in BSEd-Math Curriculum	Enrolled & Passed	Attended Training	Conducted Training	Taught Already	Willing to Teach
Fundamental Concepts of Math	12	3	0	25	9
Contemporary Math	6	1	0	19	10
College Algebra	25	7	6	29	13
Advanced Algebra	20	2	4	26	14
Trigonometry	25	5	4	30	16
Plane Geometry	24	3	3	25	10
Solid Geometry	24	1	1	21	9
Analytic Geometry	24	2	3	25	11
Calculus I	25	4	1	13	15
Calculus II	25	4	1	12	12
Set Theory and Logic	19	1	0	11	10
Number Theory	22	3	0	15	9
Abstract Algebra	20	1	0	11	10
Linear Algebra	22	1	0	13	13
Modern Geometry	16	0	0	6	13
Probability	19	2	0	13	10
Elementary Statistics	21	2	2	23	13
Advanced Statistics	14	4	1	12	6
History of Math	12	2	0	12	10
Technology in Math	8	3	2	8	12
Instrumentation in Math	7	1	0	9	7
Problem Solving in Math	9	4	1	14	8
Math Investigation and Modeling	5	3	0	8	6
Action Research in Math Education	10	5	3	12	13

For subjects in which mathematics teacher educators attended training and other related professional development activities, the highest frequencies of participants are 7 in College Algebra, 5 in Trigonometry and in Action Research in Mathematics, and 4 each in Calculus I, Calculus II, Advanced Statistics and Problem Solving in Mathematics. None attended training in Modern Geometry but one each attended training in three mathematics subjects in the old BSEd-Math curriculum and in three subjects in the revised curriculum.

A total of six mathematics teacher educators were able to conduct training in College Algebra, four each on Advanced Algebra and Trigonometry, three each in Plane Geometry, Analytic Geometry, and Action Research in Mathematics, two each in Elementary Statistics and Technology in Mathematics, and one each in five other subjects. None conducted training in four subjects in the old curriculum and seven subjects in the revised curriculum.

Subjects most commonly taught by mathematics teacher educators are Trigonometry, College Algebra, and Advanced Algebra. New subjects in the revised curriculum which have been more commonly taught by the mathematics teacher educators are Problem Solving in Mathematics, Probability, Linear Algebra, Advanced Statistics, History of Mathematics, and Action Research in Mathematics.

Subjects which were indicated as most willingly taught by the respondents are Trigonometry, Calculus I, Advanced Algebra, College Algebra, Elementary Statistics, Modern Geometry and Action Research in Mathematics, Calculus II, and Technology in Mathematics. Generally, these are subjects which the MTEs had taken as a course, attended training, or in which materials and resources are readily available.

Subjects which are least willing to be taught are Advanced Statistics, Mathematical Investigation and Modeling, Instrumentation in Mathematics, and Problem Solving in Mathematics. These subjects were commonly perceived by the MTEs to have much rigor and necessitate many requirements in teaching, especially integration of knowledge on more pre-requisite courses.

Overall, twelve (12 or 50%) of the 24 listed subjects had already been taught by mathematics teacher educators who had enrolled and passed the corresponding subjects. The other 12 subjects had been taught by those who had not taken the subjects, but had taken topics in these subjects as part of other mathematics subjects, or have attended training on said subjects.

A total of 19 (79%) subjects had been taught by MTEs who prepared by enrolling or attending training on the respective subjects. Only five (21%) subjects (Fundamentals of Mathematics, Contemporary Mathematics, Advanced Algebra, Problem Solving, and Instrumentation in Mathematics) had been taught by MTEs who neither enrolled nor attended training on the said subjects. However, topics in these subjects (except the last) are usually part of basic mathematics subjects like Arithmetic, Algebra, Geometry, Trigonometry, and Statistics.

Meanwhile, 20 (80%) subjects are willing to be taught by MTEs who enrolled and passed the corresponding subjects and four (20%) subjects by MTEs who had not taken the subjects. Finally, twenty-two (22 or %) subjects are willing to be taught by teachers who enrolled or attended training on the said subjects. Only two (8%) subjects (Technology in Mathematics and Contemporary Mathematics) are willing to be taught by MTEs despite not having taken and attended training on the said subjects.

Hence, the foregoing discussions may imply that in order to improve the number of qualified MTEs who are willing to teach especially the new mathematics courses in the revised curriculum, opportunities can be provided for advanced studies, seminars, and training of MTEs. Other professional development activities can be explored like lesson study, mentoring, and collaboration among the faculty. (Bubb, 2005; SEI & MathTEd, 2011).

The mathematics teacher educators surveyed demonstrated various adaptations of the BSEd-Math curriculum through inquiry-based teaching-learning activities and technology integration in their classes. They were asked to indicate responses concerning inquiry-based activities in survey questions numbered 3, 4, and 5. For technology integration, they answered survey questions numbered 6 to 9. As in curriculum adaptation at the institutional level, the criteria for extent of curriculum adaptation at the classroom level are based on a 5-point scoring rubric for *adoption time*, *compliance level,* and *degree of innovation used.*

Inquiry-based approaches in teaching mathematics. The first criterion for assessing extent of curriculum adaptation at the classroom level is based on their use of inquiry-based approaches in teaching mathematics classes in the BSEd-Math curriculum. Included in the items are selected inquiry-based teaching-learning activities such as problem solving, practical work, cooperative learning, mathematical investigation, and related inquiry-based activities. Problem solving activities enable students to formulate and solve various types of problems using a variety of techniques and strategies for solving problems. Through practical work, students learn mathematical concepts and relationships as well as develop critical thinking and problem skills through observation and manipulation of concrete objects or models, and related hands-on learning opportunities. Cooperative learning activities allow students to learn from each other as they work by pair or collaborate in groups on certain tasks or projects. Mathematical investigations provide opportunities for students to apply their mathematical knowledge and skills and discover solutions of various types of problems through exploratory activities and research-based investigatory projects in mathematics.

Adoption time. Mathematics teacher educators were asked to indicate when they typically start using inquiry-based teaching-learning activities in their mathematics classes in the BSEd curriculum. Table 20 shows the frequency of their responses for each inquiry-based activity.

Table 20

Adoption Time of Inquiry-Based Activities (n=37)

Inquiry-Based Activity	Adoption Time					*Weighted Mean*	*SD*
	At Start of Classes (5)	Before Prelim (4)	Before Midterm (3)	Before Finals (2)	Never (1)		
Problem solving	11	14	8	2	2	3.81*	1.10
Practical work	12	10	12	1	2	3.78*	1.27
Cooperative learning	18	6	9	3	1	4.00*	1.15
Mathematical investigation	7	9	5	10	6	3.03**	1.40
Overall Rating						3.66*	0.88

* *early*
** *late*

The respondents indicated that they typically start using problem solving before preliminary examinations, practical work at the start of classes or before mid-term examinations, and cooperative learning at the start of classes. The use of mathematical investigation typically starts before the final examination but six respondents indicated that they have not used mathematical investigation at all. The delay in introducing mathematical investigations near the end of the term may be deterrent to the students' development of the needed critical and creative thinking skills and competencies. Usually, there are more requirements to be completed near the end of the term. Early exposure could provide students more time to reflect and come up with more interesting discoveries.

On the 5-point rating scale where 1 the lowest and 5 the highest rating, the weighted means of corresponding coded data in reverse order indicate early adoption of problem solving, practical work, and cooperative learning. The computed mean of 3.03 indicates late adoption of mathematical investigation by the respondents.

The results were confirmed by the frequency distributions of responses, which tend to be skewed toward early adoption, except for mathematical investigation in which variation of responses showed wider variation (*SD* = 1.4) indicating a 46% variation from the mean. Overall, however, the mathematics teacher educator respondents indicated early adoption of inquiry-based activities in their mathematics classes, with responses varying from the mean by 24%.

The results were further supported by their responses to the open-ended questions of the survey questionnaire. Asked to indicate what they usually do if or when there is a new material, strategy or technology in teaching mathematics, 18 (49%) mentioned *early adoption*, 10 (27%) indicated *late adoption*, and 9 (24%) have hesitations or no response.

Early or *prompt adoption* is indicated by immediate use and implementation of the new material, strategy or technology in teaching mathematics by the mathematics teacher educators in their mathematics classes, with students and teachers. The following quoted responses generally indicate readiness and early adoption (Rogers, 1995):

- "adopt it"
- "apply it to my class"
- "use and teach to my students"
- "introduce it right away in the class"
- "share it to my colleagues and students"
- "explore and encourage students to do so"

Meanwhile, *late adoption* is indicated by slow or delayed implementation by mathematics teacher educators with extended time for inquiry and learning before actual use or implementation in their mathematics classes. The following responses are indications of delay or late adoption by mathematics teacher educators (Rogers, 1995), consistent with the findings of Penuel et al. (2007) on the importance of the element of time in adopting an innovation:

- "give time for it to be learned"
- "find time to research or study about it"
- "make inquiries if that material really works"
- "go through the process of appraising, experimenting and adapting"

Generally, if there is a new material, strategy or innovation in teaching mathematics, early adoption is the most typical action by mathematics teacher educators. This validates the extent of adaptation by the MTEs which typically indicated early adoption of inquiry-based teaching strategies. Grouped as to SUC-TEI category, early adoption and late adoption are typically done by the MTEs in the middle-performing and high-performing institutions. However, late adoption and non-adoption are typically done by mathematics teacher educators in the low-performing institution.

Compliance level. The teacher respondents were also asked to indicate the number of mathematics subjects in the BSEd-Math curriculum in which they have used inquiry-based teaching-learning activities in their classes. The corresponding percent of the total number of mathematics subjects taught in BSEd-Math was computed for each respondent in each inquiry-based activity. To simplify the data, equivalent ratings were coded (1 for "Below 20%" to 5 for "80 to 100%"); means and standard deviations were computed. The average number of subjects in which teacher respondents have used each inquiry-based activity, the mean percent of mathematics subjects they have taught in the BSEd-Math curriculum, as well as the corresponding mean ratings and standard deviations of the ratings for level of compliance are summarized in Table 21.

Table 21

The Teacher Educator Respondents' Compliance Level in Using Inquiry-Based Activities (n=37)

Inquiry-Based Activity	Average Number of Math Subjects	Mean Percent of Math Subjects Taught	*Mean Rating*	*SD*
Problem Solving	4.70	45.0	3.21*	1.29
Practical Work	3.06	33.5	2.79*	1.22
Cooperative Learning	3.42	36.9	2.94*	1.20
Mathematical Investigation	2.09	23.7	2.45**	1.06
Overall Rating			2.85*	1.09

Legend: Rating Equivalent %

Rating	*Equivalent %*
1	*Below 20*
2	*20 to 39*
3	*40 to 59*
4	*60 to 79*
5	*80 and above*

* *moderate*
** *low*

On the average, the mathematics teacher educator respondents typically used problem solving in about five mathematics subjects, or 45% of the total number of mathematics subjects, they have taught in the BSEd-Math curriculum. They indicated having used cooperative learning and practical work in three mathematics subjects, or in more than one-third of the total number of mathematics subjects they have taught in the BSEd-Math curriculum. They also reported having used mathematical investigation in two mathematics subjects which accounts to about 24% of the total number of mathematics subjects they have taught in the BSEd-Math curriculum. In general, the mathematics teacher educators showed a moderate level of compliance in using inquiry-based teaching-learning activities in their mathematics classes, with responses varying from the overall mean by 38%.

Degree of innovation used. The teacher respondents were further asked to indicate how frequently they have used inquiry-based activities in their mathematics classes as an innovation in the implementation of the revised BSEd-Math curriculum. Most of them indicated that they "often" use problem solving, practical work, and cooperative learning in their mathematics classes. The computed statistics of the equivalent ratings for each corresponding activity are summarized in Table 22.

The mean ratings indicate that the teacher educators tend to show high innovation in using problem solving, practical work, and cooperative learning but show moderate innovation in mathematical investigation. A common reason indicated by MTEs is limited time to finish some activities, especially mathematical investigations. Variations of responses from their respective means are almost similar, the standard deviations are all close to 1. Overall, the teacher respondents tend to show high innovation in using inquiry-based teaching-learning activities in their mathematics classes, with responses varying from the overall mean by about 23%.

Table 22

Degree of Innovation Based on Teachers' Self-Reported Use of Inquiry-Based Activities (n=37)

Inquiry-Based Activity	*Mean*	*SD*
Problem Solving	4.16**	0.87
Practical Work	3.70**	1.15
Cooperative Learning	3.59**	0.96
Mathematical Investigation	3.08*	1.12
Overall Rating	3.64**	0.85

Legend:

Rating	*Description*
1	*Never*
2	*Seldom*
3	*Sometimes*
4	*Often*
5	*All the time*

* *moderate innovation*
** *high innovation*

Likewise, the students were also asked to assess the mathematics teacher educators' use of inquiry teaching in their mathematics classes. Being the center of the teaching-learning process, the students are primary stakeholders of curriculum implementation. Students, therefore, are also key informants about curriculum adaptation especially at the classroom level. Specifically, the students indicated how frequently their teachers have used each of the corresponding inquiry-based activities in their classes. Using a 5-point scale, the corresponding responses were coded and descriptive statistics such as mean (*M*) and standard deviation (*SD*) were computed from the equivalent scores. According to the students, typically, the mathematics teacher educators often use problem solving (*M* = 4.47, *SD* = 0.92), practical work (*M* = 3.97, *SD* = 0.82), and cooperative learning (*M* = 3.63, *SD* = 1.18) in their mathematics classes.

However, on the average, mathematics teacher educators are presumed to sometimes use mathematical investigation (*M* = 3.25, *SD* = 0.88) in their classes. Overall, the students indicated that the teacher educators often use inquiry-based teaching strategies (*M* = 3.83, *SD* = 0.63) in their mathematics classes

In general, mean ratings by the students are close to their teachers' mean self-ratings in the use of inquiry-based activities. Categorically, the students' responses validated the teachers' high innovation in the use of inquiry-based teaching. Moreover, the students indicated on the 1 to 5 scale how effectively their mathematics teachers have used inquiry-based teaching strategies in their classes. The overall mean rating of 4.16 (*SD* = 0.58) indicates that students generally regard effective use of inquiry-based teaching strategies by their mathematics teachers.

Somewhat expected, students favor subjects that focus on inquiry, discovery, practical applications, collaboration, fun, and other more engaging and active learning activities consistent with the inquiry mathematics tradition (Bernardo, 2002). Asked what was their most favorite mathematics subject in the BSEd-Math curriculum, the students gave different answers. Nine (28%) considered Advanced Algebra as their favorite. Five (16%) mentioned Plane Geometry while four (13%) each mentioned Contemporary Mathematics, Trigonometry, Calculus, and Number Theory. Three (9%) each answered College Algebra, Solid Geometry, Elementary Statistics, and Problem Solving. Two (6%) each indicated Analytic Geometry, Abstract Algebra, Modern Geometry, Advanced Statistics, and Mathematical Investigation and Modeling. Only one (3%) each mentioned Fundamentals of Mathematics, Linear Algebra, and Probability.

Students gave various reasons for choosing their most liked mathematics subjects in the BSEd-Math curriculum. Eighteen (56%) gave reasons that fall under the category of inquiry-based learning opportunities while 14 (44%) mentioned other reasons or benefits. In general, the students from the three categories of institutions gave more reasons under inquiry-based learning opportunities.

Reasons classified under inquiry-based learning opportunities include favoring subjects that enhance students' critical thinking and problem solving skills, provide practical applications in real-life situations, and "make learning mathematics fun and challenging". As one student said, "I had fun learning math… I enjoy and love the subject." Another student claimed: "Solving equations is my playground where I play numbers and manipulate formulas. It gives me thrill to solve and think logically." Another student asserted, "We are able to learn the beauty of mathematics while having fun."

In contrast, some students favored subjects where lessons or topics are easy to understand. As one student said, "Because unlike other subjects, these are easy to understand and the formulas are limited." Another student mentioned: "It is the foundation of higher mathematics… That's why when it comes to this subject I'm always interested." But according to one student, "I treat all my subjects equally. I don't favor a subject just because of the teacher."

Meanwhile, as reported by the administrators who observed classes in the BSEd-Math curriculum, the mathematics teacher educators had demonstrated the use of various inquiry-based teaching strategies in their mathematics classes. A total of 21 MTEs (four in the low-performing institution, seven in two middle-performing institutions, and 10 in three high-performing institutions) were observed by the administrators in their respective mathematics classes as follows, with the corresponding frequencies (f):

- Basic Mathematics (f=3)
- College Algebra (f= 1)
- Contemporary Mathematics (f=1)
- Trigonometry (f=2)
- Analytic Geometry (f=1)
- Integral Calculus (f=1)
- Abstract Algebra (f=1)
- Linear Algebra (f=1)
- Business Mathematics (f=3)
- Statistics (f=3)
- Problem Solving in Mathematics (f=2)
- Technology in Mathematics (f=1)
- Strategies in Teaching Mathematics (f=1)

The MTEs were observed for both inquiry and technology in five general education mathematics classes, four pre-calculus and analysis classes, two higher mathematics classes, six business mathematics and statistics classes, and four new mathematics education classes. Using the Classroom Observation Checklist (Appendix H), the MTEs were rated along the 5-point scale from 1 (not observed) to 5 (very much observed) based on their observed use of inquiry-based teaching strategies and integration of technology in their mathematics classes. The last part of the classroom observation instrument sought over-all impressions and observations about the teachers, the students, and the lessons.

From the administrators' classroom observations of the MTEs' BSEd-Math classes, equivalent scores were inferred from the corresponding ratings on the observed indicators. Indicators for the use of inquiry-based teaching strategies were typically *much observed* (M = 4.31, SD = 0.31) with mean ratings ranging from 4.24 to 4.38. The highest average ratings were obtained for *engaging students in active participation and cooperative learning* (M = 4.38, SD = 0.67) and *use of alternative assessment of students' learning* (M = 4.38, SD = 0.50). In general, the mean observation ratings by the administrators show very good indications about the mathematics teachers' use of inquiry-based strategies. Categorically, the corresponding descriptions indicate high innovation in the use of inquiry-based strategies by the MTEs in their mathematics classes.

The administrators' overall impressions and observations about the teachers, the students, and the lessons in BSED mathematics classes that they had observed qualitatively complement the corresponding mean ratings with regard to the observed use of inquiry-based teaching strategies by the MTEs in the BSEd-Math classes. General impressions and comments about the teachers and the students were very favorable as the following remarks indicate:

- "There is evidence of planning. Activities are organized."
- "The teacher utilized inquiry-based approach in teaching."
- "Students show willingness to learn. They are participative."
- "Students listen attentively and ask questions whenever there are unclear

concepts discussed."

- "They listen attentively and participate in classroom activities."

The following remarks also describe the overall impressions about the lessons and the teaching-learning activities observed by the administrators:

- "well-planned and organized lesson and activities"
- "used variety of activities related to the lesson"
- "interesting and practical lesson"
- "Lesson has real life application."
- "Cooperative learning is evident in the activities."

The foregoing discussions show a considerable agreement among the responses of the teachers, the students, and the administrators providing support to the MTEs' typically high innovation and frequent use of inquiry teaching in their mathematics classes, a scenario that is better than what was in the study of Pedro (1996). Hence, the findings validate the implementation of an inquiry-based BSEd-Math curriculum among SUC-TEIs in the region, a common observation in many of the 17 participating countries in the IEA international study on mathematics teacher education (Tatto et al., 2012).

Integration of technology in teaching mathematics. The second criterion for assessing extent of curriculum adaptation at the classroom level was based on the use of technology integration in teaching mathematics classes in the BSEd-Math curriculum. The items focused on the use of selected technologies such as graphing calculators, computer algebra systems, electronic spreadsheets, Internet and related technologies. Asked about their purpose in integrating technology in their BSEd-Math classes, the teacher respondents indicated various reasons. Thirty-one (84%) indicated use of technology for numerical computation, 26 (70%) for graphical presentation, 25 (68%) for interactive learning, 23 (62%) for tabular presentation, 22 (60%) for symbolic manipulation, and 1 (3%) for other related purposes. As expected the results were similar to the findings of Kersaint et al. (2003) that mathematics teacher educators at the secondary level integrate more mathematics specific technologies than those at the elementary level with limited technology integration in mathematics.

The teacher respondents were also asked to characterize their participation and that of their students in the use of technology in their BSEd-Math classes. Twenty-five (25 or 68%) said they allow students to use technology during their mathematics classes while 23 (62%) indicated that, together, the students and the teachers make use of technology during their mathematics classes. However, 15 (41%) demonstrate use of technology in class but let students practice outside the class, while 12 (32%) encourage their students to use technology but not during their class. Only two (5%) indicated that they and their students do not use technology in their mathematics classes.

Adoption time. The mathematics teacher educators were asked specifically to indicate the portion of the course when they typically started integrating the use of technology in their mathematics classes. Some indicated that they have used graphing calculators (71%), computer algebra systems (37%), electronic spreadsheets (66%), and the Internet (66%) in their mathematics classes at any point of a given term. However, there were also those who had not integrated technology in any of their mathematics classes, especially computer algebra systems (63%). Table 23 shows the corresponding numbers of those who integrated each technology at the indicated portions of the class term.

The responses were coded in reverse order, and descriptive statistics were computed for each corresponding technology. With 1 as the lowest and 5 as the highest rating, the weighted means indicate late adoption of graphing calculators, electronic spreadsheets, and Internet and web technologies but very late adoption of computer algebra systems. The standard deviations confirm the heterogeneity of the responses for each indicated technology. In general, the mathematics teacher educators indicated late adoption of technology in their mathematics classes, the most typical non-adoption was for computer algebra systems. The responses are quite heterogeneous, with 42% variation from the mean.

Table 23

Adoption Time of Technology in Mathematics During the Term (n=37)

Technology in Mathematics	Adoption Time: At Start of Classes (5)	Before Prelim (4)	Before Midterm (3)	Before Finals (2)	Not at All (1)	*Weighted Mean*	*SD*
Graphing Calculators	8	10	5	2	10	3.11*	1.62
Computer Algebra Systems	3	3	4	3	22	1.91**	1.39
Electronic Spreadsheets	4	8	6	5	12	2.63*	1.46
Internet & Web Technologies	9	5	6	3	12	2.89*	1.64
Overall Rating						2.64*	1.11

* *late*
** *very late*

The results were somewhat expected because a common problem indicated by the MTEs and students is lack or limited laboratory facilities and technologies for teaching mathematics with technology integration. Delay in the adoption of technology is consistent with the common observation that the MTEs need adequate time to identify and learn software appropriate and relevant to their lessons (CITEd, n.d.). With the latest trend in mobile computing, however, there are currently more opportunities for technology integration using smartphones, tablet computers, as well as online and downloadable applications and related resources in mathematics.

Compliance level. For level of compliance, the mathematics teacher educators were asked to indicate the number of mathematics subjects in the BSEd-Math curriculum in which they have integrated the use of technology in their mathematics classes. The corresponding percent of the total number of mathematics subjects taught in the BSEd-Math curriculum was computed for each teacher respondent and for each technology. Equivalent ratings were coded (1 for "Below 20%" to 5 for "80% to 100%"), and means and standard deviations were computed. Table 24 shows the average number of subjects in which MTEs have integrated technology, the mean percent of mathematics subjects they have taught in the BSEd-Math curriculum, and the corresponding mean ratings and standard deviations for level of compliance.

On the average, the mathematics teacher educators typically integrated the use of graphing calculators and the Internet in two mathematics subjects (or a little less than one-fourth of the total number of mathematics subjects they have taught in the BSEd-Math curriculum). Typically, they indicated having used electronic spreadsheets in more than one mathematics subject, or about 16% of the total number of mathematics subjects, they have taught in the BSEd-Math curriculum. They also reported having integrated the use of computer algebra systems in about one mathematics subject, which accounts for about 8% of the total number of mathematics subjects they have taught in the BSEd-Math curriculum.

The mean ratings indicate low compliance for graphing calculators, electronic spreadsheets, and the Internet; but very low compliance for computer algebra systems. Computed standard deviations are close to 1 with variation of responses from their corresponding means ranging from 48% to 60%. Overall, the mathematics teacher educators indicated low compliance in integrating the use of technology in their mathematics classes with 56% variation of responses from the overall mean.

Table 24

Level of Compliance in Integrating Technology in Mathematics (n=37)

Technology in Mathematics	Average Number of Math Subjects	Mean Percent of Math Subjects Taught	*Mean Rating*	*SD*
Graphing Calculators	1.97	21.36	2.29*	1.15
Computer Algebra Systems	0.77	8.27	1.49**	0.89
Electronic Spreadsheets	1.29	15.70	1.94*	0.94
Internet & Web Technologies	2.26	24.71	2.31*	1.30
Overall Rating			2.01*	0.76

Legend:	*Rating*	*Equivalent %*		
	1	*Below 20*	*	*low*
	2	*20 to 39*	**	*very low*
	3	*40 to 59*		
	4	*60 to 79*		
	5	*80 and above*		

This is supported by the responses of the students which indicated that the MTEs either provided limited opportunities or had not used technology integration at all due to inadequate or lack of laboratory facilities such as computers and Internet access, consistent with a similar finding by CITEd (n.d.).

Degree of innovation used. The teacher respondents were also asked to indicate how frequently they integrated technology in their mathematics classes as another innovation in the BSEd-Math curriculum. Many indicated that they had never used computer algebra systems (63%), electronic spreadsheets (31%), graphing calculators (29%), and Internet (29%) in their mathematics classes. But more indicated (from seldom to always) having used graphing calculators (71%), Internet (71%), and electronic spreadsheets (69%).

Descriptive statistics were computed from the coded responses (1 for "Never" to 5 for "Always"). Table 25 shows the computed means and standard deviations for mathematics educators' degree of innovation in technology integration.

Table 25

Mathematics Teacher Educators' Degree of Innovation in Technology Integration (n=37)

Technology in Mathematics	*Mean*	*SD*
Graphing Calculators	2.69*	1.32
Computer Algebra Systems	1.91**	1.40
Electronic Spreadsheets	2.71*	1.43
Internet & Web Technologies	2.86*	1.44
Overall Rating	2.54*	1.11

Legend:

Rating	*Description*
1	*Never*
2	*Seldom*
3	*Sometimes*
4	*Often*
5	*All the time*

* *moderate*
** *low*

The mean ratings indicate that mathematics teacher educators show only a *moderate* innovativeness in using graphing calculators, electronic spreadsheets, and the Internet, but low innovation in using computer algebra systems. The standard deviations are all greater than 1, with responses varying from their corresponding means by 49% to 73%. Overall, the mathematics teacher educators surveyed tend to show innovation in integrating technology in their mathematics classes only to a moderate extent with responses varying from the overall mean by 44%.

As expected, the observations of the administrators supported the teachers' moderate use of technology as indicated by the mean observation ratings from 2.95 to 4.0. According to the administrators, the MTEs demonstrated "much use" of slide presentations ($M = 4.0$, $SD = 0.55$) but moderate use of the Internet and web technologies ($M = 3.44$, $SD = 0.62$), scientific and graphing calculators ($M = 3.29$, $SD = 1.10$), electronic spreadsheets ($M = 3.19$, $SD = 1.03$), and computer algebra systems and mathematical software ($M = 2.95$, $SD = 1.20$). Overall, use of technology integration by mathematics teacher educators was moderately observed ($M = 3.44$, $SD = 0.58$), categorically equivalent to the mean self-rating by the MTEs.

The administrators' overall impressions and observations also included positive descriptions of the teachers' use of technology in their mathematics classes as indicated by the following remarks:

- "The teacher is very knowledgeable about the use of computer software related to what she is teaching."
- "The teacher has mastery of the lesson and made use of technology in teaching."

The favorable perceptions of the administrators about the MTEs' use of inquiry-based activities and technology integration can be attributed to the fact that observations of mathematics teachers by the administrators were not really done on a daily basis.

Hence, the administrators' observations may not have been able to completely capture the day-to-day activities and interactions between the mathematics teachers and their students. Only six institutions have available data from classroom observations of 21 teachers. Teachers may also tend to perform better in the presence of their supervisors, very likely because they think results of the observations would be considered in the evaluation of their teaching performance.

Meanwhile, all the students in the interview indicated that their mathematics teachers use scientific calculators in their mathematics classes. However, according to the students, the MTEs almost never use graphing calculators ($M = 1.47$, $SD = 0.98$) and computer algebra systems ($M = 1.28$, $SD = 0.58$), seldom use electronic spreadsheets ($M = 2.31$, $SD = 1.26$) and the Internet ($M = 2.44$, $SD = 1.44$), but sometimes use slide presentations ($M = 2.91$, $SD = 1.38$) in their mathematics classes. Overall, the students indicated that the mathematics teacher educators seldom or occasionally use technology integration ($M = 2.08$, $SD = 0.84$) in their mathematics classes.

Asked how much they learned from mathematics instructors/professors who integrated technology in their mathematics classes, the students gave a variety of answers. Twenty-three (23 or 72%) indicated that they had learned much, three (9%) have not learned much, and six (19%) said they had not learned at all because their teacher did not integrate technology in their mathematics classes. In general, students from the three SUC-TEI categories most frequently answered that they had learned much from their mathematics teachers who integrated technology in their mathematics classes.

The following responses indicate that students have learned much from their mathematics teachers who integrated technology in their mathematics classes, from motivation to various phases of the teaching-learning process.

- "Integration of technology in the mathematics class motivates me because mode of instruction is more simplified and clear. It arouses our interest to learn more."
- "I've learned quite well. The use of scientific calculator simplifies the work so we learn easier."
- "When we are using technology we see the application of what we have learned."
- "I learned techniques, concepts and other methods in solving mathematical problems with the integration of technology and I found out that it is easier when technology is integrated."
- "I learned a lot about math software and websites because they make me and other students explore our topic."

Some students were fascinated with the use of technology in actual teaching. According to one, "I've learned a lot most especially in using ICT-based presentation in teaching." Another said, "It can help me as a future teacher. That's why I have learned a lot." Another concluded: "Through integration of technology learning math became more interesting and lively." One simply said, "So far, with a math instructor who integrated technology in my math class, I'm learning the lessons very well."

For other students, however, use of some technologies in their mathematics classes limits their capacity to learn that they prefer traditional teaching with occasional use of technology.

- "Actually I prefer the discussion without integrating technology because somehow using slide presentation, for example, makes the students passive."
- "Sometimes it depends upon the topic that they are discussing. Although they don't use technology very often except the calculator, we still learn from them."
- "It is better to use the traditional method especially in step-by-step solution, the chalkboard is more effective for us than PowerPoint presentation."

Others, however, missed the opportunity for technology integration in their mathematics classes as indicated by the following responses.

- "Instructors are not using technology integration during math classes."
- "Our teachers only use the traditional way of teaching."
- "Instructors did not integrate technology during math classes because of lack of facilities and support from the administration."

Despite this lack of opportunity however, one student said: "Honestly we lack integrated technologies but the ability and knowledge of our instructors is enough for us to learn and to understand every lesson." Another remarked, "Even though the instructors did not integrate technology in math classes, I learned more from them compared to our high school teachers."

The preceding discussions, therefore, have indicated general agreement between the perceptions of the teachers and their students about the MTEs' inquiry-based teaching practices in BSEd mathematics classes. Responses of mathematics teacher educators and perceptions of students as well as observations of administrators indicated that mathematics teacher educators typically demonstrated high innovation on the use of inquiry-based activities but low to moderate use of technology integration. Perfect agreement was observed among the high ratings by the three groups of stakeholders from the three categories of institutions for inquiry-based activities. In technology integration, however, Table 26 shows a considerable agreement among the descriptions of the corresponding ratings by the three groups of respondents from the three categories of institutions.

Table 26

Description of MTEs' Extent of Technology Integration according to Respondents across SUC-TEI Categories

Respondents	SUC TEI Category		
	Low-Performing	Middle-Performing	High-Performing
MTEs	Low	Moderate	Low
Students	Very Low	Moderate	Low
Administrators	Moderate	Very High	Moderate

The corresponding descriptions indicate an almost perfect agreement between the perceptions of the MTEs and their students about the teachers' use of technology integration in their mathematics classes. However, administrators' mean ratings were generally favorable to the MTEs in both inquiry-based activities and technology integration. Biased as they may seem, administrators' observations provided some support to the similar assessment of teachers and students that curriculum adaptation by the MTEs at the classroom level show indications of promptness, compliance and innovation.

Factors of Curriculum Adaptation

This section explores various factors associated with curriculum adaptation at the institutional and classroom levels. At each level, the underlying factors of curriculum adaptation were drawn from the quantitative and qualitative analyses of the data.

Factors of curriculum adaptation at the institutional level. Initially, through linear regression, institutional characteristics were used to predict extent of curriculum adaptation at the institutional level. Subsequently, other institutional factors were also inferred from the data through critical comparative analysis of responses and documents.

Institutional characteristics as predictors of curriculum adaptation. Using linear regression, the selected institutional characteristics were used as predictors of extent of curriculum adaptation at the institutional level. With a sample size of only 10 SUC-TEIs in Central Luzon, simple linear regression (SLR) was used with only one predictor variable entered in each regression model. 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 extent of curriculum adaptation.

Table 27 shows the beta coefficients, coefficients of determination, and the corresponding test statistics (t-values) and significance levels (p-values) between the institutional characteristics and the three indicators of extent of curriculum adaptation. Compared to the other predictor variables in Table 27-A, only *number of campuses* has a large but negative effect (*Beta* = - 0.58) on *adoption time,* explaining about 33 percent variation (r^2) in the time of adoption by the SUC-TEIs. Hence, SUC-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 of zero linear regression coefficient.

Meanwhile in Table 27-B, *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 SUC-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.

Table 27

Linear Regression between Institutional Characteristics and Extent of Curriculum Adaptation (N=10)

A. Institutional Characteristics as Predictors of Adoption Time

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

B. Institutional Characteristics as Predictors of Compliance Level

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

C. Institutional Characteristics as Predictors of Degree of Innovation

Institutional Profile Variable	Degree of Innovation Made			
	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

* *significant at 5% level*

In contrast, 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. Hence, *number of accredited programs* is the only predictor variable found to have a significant effect on *compliance level* (please refer to the regression outputs in Appendix K).

On the other hand, as shown in Table 27-C, *number of campuses* has a positive but small effect (0.14) while the other institutional characteristics manifest a negative effect on *degree of innovation made*. 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 SUC-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.

Structural setup of State TEIs. Typically, six state TEIs offering mathematics courses in the College or Institute of Education demonstrated prompt adoption ($M = 3.67$, $SD = 0.82$), high compliance ($M = 3.67$, $SD = 0.82$), and moderate innovation ($M = 3.33$, $SD = 0.82$) in implementing the revised BSEd-Math curriculum. Meanwhile, four top performing institutions holding mathematics classes at the service colleges and departments (College of Arts and Sciences, Department of Mathematics) or borrowing faculty from other Colleges (like Engineering and Computer Science) to handle some mathematics courses manifested very prompt adoption ($M = 4.75$, $SD = 0.50$), very high compliance ($M = 4.50$, $SD = 0.58$), and moderate innovation ($M = 3.0$, $SD = 1.41$). The t-test, however, indicated significant mean difference only in adoption time, $t(8) = 2.35$, $p = 0.047$. Hence, the structural setup of the state TEIs is a significant factor of institutional adoption time. This may indicate that having a service college with a mathematics department ensures availability of qualified mathematics faculty to handle the mathematics courses, contributing to earlier adoption of the revised curriculum.

Institutional factors drawn from qualitative data. In order to facilitate comparative analysis across institutions and explore the underlying factors of curriculum adaptation at the institutional level, a summary of the extent of curriculum adaptation for each institution is presented in the succeeding paragraphs.

SUC1 is a multi-campus Level III state university with 23 programs accredited by the AACCUP, including the BSEd program with Level III re-accredited status. The institution receives an average annual budget allocation of about 200 million pesos from the national government, the second highest among SUCs in Region III. With very high indicated compliance with the CHED memorandum, the SUC-TEI adopted the revised BSEd curriculum in School Year 2005-2006, offering the minimum number of required units with two innovations namely: including one mathematics subject in general education and another mathematics specialization subject.

SUC2 is an internationally recognized state university with all its 26 programs accredited by AACCUP, the highest Level IV status awarded to its BSEd and BEEd programs. As a Center of Excellence in Teacher Education and in other programs in agriculture, it has the highest budget allocation in Region III with almost 300 million average annual allocation from the government. With very prompt adoption and very high compliance, it leads all the other SUC-TEIs in the region in offering all the prescribed mathematics subjects in the Revised BSEd-Math curriculum beginning School Year 2005-2006.

SUC3 is one of the two oldest institutions among all SUC-TEIs in Region III. It is a multi-campus Level II state university with seven of its academic programs accredited by AACCUP. With an average annual allocation of about 90 million pesos, its Level III BSEd program was among the SUC-TEIs with very prompt adoption and high compliance in offering the new curriculum in School Year 2005-2006. The institution managed to adapt the Revised curriculum by incorporating innovations like adding a mathematics subject in general education, replacing a prescribed major subject by another subject, and adding another major subject.

SUC4 is a Level III state college with about 90 million budget allocation. It has 20 accredited programs, including the BSEd program with Level III re-accredited status. Characterized by very prompt adoption and high compliance, it offered the revised curriculum with three types of innovation such as increasing the number of units of two mathematics general education subjects and of two major subjects, adding two major subjects, and combining a new major with an old major subject.

SUC5 is a multi-campus Level III state university with about 140 million average budget allocation and 30 AACCUP-accredited programs. From Level II re-accredited status, the BSEd program had been preparing for Level III accreditation. Offering the Revised curriculum starting School Year 2006-2007, the institution complied with the prescribed number of mathematics subjects but added two mathematics subjects in general education, increased the number of units of four 3-unit majors to 5 units, and added two major subjects.

SUC6 used to be a Level III state college with around 90 million average annual allocation. With 13 programs accredited by AACCUP, the institution attained Level III status for its BSEd program. With prompt adoption, high compliance, and high innovation in offering the revised curriculum, it offered the required subjects with three types of innovations like combining two prescribed subjects into one major subject, increasing the number of units of a major subject, and adding another major subject.

SUC7 is a multi-campus Level II state college. As the youngest institution among the SUC-TEIs in the Region, it also has the lowest annual budget allocation of about 34 million pesos. However, in compliance with the CHED memorandum, the institution offered the Revised BSEd curriculum starting School Year 2006-2007, offering the required number of units in mathematics but with three types of innovations such as including mathematics subjects from the old curriculum, increasing the number of units of two prescribed major subjects, and combining two major subjects in one major subject.

SUC8 is a multi-campus Level III state university with about 130 million average annual budget allocation. It has the highest number of programs accredited by AACCUP among SUCs in Region III, with the BSEd program awarded with Level III re-accredited status. Starting 2007-2008, it was able to offer the minimum required number of units, with 2 additional units and one additional major subject.

SUC9 is a multi-campus Level III state university with the largest number of satellite campuses among all SUCs in Region III. It has an average annual budget allocation of about 170 million pesos, the third highest in the Region. It has 13 programs accredited by AACCUP, including the BSEd program with Level III re-accredited status. The SUC-TEI indicated very high compliance with the CMO, but started offering the Revised Curriculum in 2007-2008 with three types of innovations like offering the mathematics general education subjects from the old curriculum, combining two major subjects in one subject, and replacing a prescribed major subject by another mathematics subject.

SUC10 is a multi-campus Level III state university with around 90 million annual allocation from the national government. It has 12 programs accredited by AACCUP, the BSEd program with level II status. The institution indicated very high compliance with the CMO. However, it started offering the Revised Curriculum only during School Year 2007-2008, all the 20 prescribed major subjects but the two mathematics general education subjects from the old curriculum.

Critical comparative analysis of institutional profile, open ended-response data from stakeholders, observations, and documents revealed more meaningful insights about factors associated with curriculum adaptation at the institutional level (Please see Appendix I for sample summary tables). Of the 10 institutions, seven demonstrated early adoption; the other three showed late adoption. Also, seven institutions have a high level of compliance while the other three, low level of compliance. Five institutions each demonstrated high and low innovation, respectively, in implementing the Revised BSEd-Math curriculum.

Using the recoded values for extent of adaptation (*low* for values less than or equal to 3, and *high* for values greater than 3), the institutions were classified into groups that showed either low or high levels of adaptation. The institutions which demonstrated very early adoption of the revised curriculum include the oldest state institution and the first two state universities in Central Luzon. Early adoption is also manifested by the second oldest and the three youngest state institutions in the sample. Of these seven institutions, four were the first, and three were the last to offer a mathematics specialization in secondary teacher education. Late adoption, however, was demonstrated by three institutions which have existed for more than 100 years, or were among the first institutions to offer mathematics specialization. Neither historical background nor institutional leveling and accreditation guaranteed early adoption among institutions, as late adopters also include Level III institutions with more than 10 accredited programs and Level III accreditation for the BSEd program.

Early adopters also include three institutions with only one campus and the smallest budget allocations and four multi-campus institutions with the largest budget allocations. In effect, these seven institutions have the largest ratios of budget allocation to number of campuses. In contrast, late adopters are the three institutions with the lowest ratios of budget to number of campuses despite being multi-campus institutions. Hence, a more feasible explanation for early adoption relates to capability of the institutions to manage their campuses subject to availability and adequacy of resources.

The problems mentioned by the administrators in implementing the revised BSEd-Math curriculum also gave additional insights about institutional factors of curriculum adaptation. In the low-performing institution with delayed implementation of the Revised BSEd curriculum, a peculiar but isolated administration-related problem is *frequent change in the designated Dean of the College of Education* (referring to the six deans in the last five years). Another problem encountered is "*overloaded mathematics* *teachers. Some math teachers from other colleges have occasional load in the College of Education".* Likewise, one middle-performing institution noted, *"Most of our math teachers in the Institute of Teacher Education handle both the high school and college general education and math major subjects. Hence, math teachers are really overloaded."* The low-performing institution also mentioned *"lack of books for major subjects".* Another high performing institution indicated *"unavailability of books for major subjects ... subjects are the same to that of the graduate school".* One high-performing and two middle-performing institutions indicated *"none"* or *"no problems encountered".*

The interventions done by the institutions revealed more interesting insights about their extent of curriculum adaptation. According to the administrators, review and revision of the BSEd-Math curriculum as well as faculty preparation and participation were the common interventions done by the institutions for effective implementation of the BSEd-Math curriculum. In one high-performing institution, *"major subjects were reviewed by mathematics teachers from the College of Science, a service college where they belong".* Likewise, the Institute of Education of a middle-performing institution also *"asked the assistance of mathematics experts such as the BS Math and Engineering faculty members from the other institutes"* of the institution. Even in the low-performing institution, *"mathematics faculty members from other colleges of the university were involved in the curriculum review".*

Another common intervention done by all SUC-TEIs is preparing the faculty by *"sending them to seminars and trainings".* Except for the low-performing institution, *"monitoring and observation of classes"* as well as *"strict admission policy for qualified* *majors in mathematics"* are also important measures taken by SUC-TEIs for effective implementation of the revised curriculum. As mentioned in one high-performing institution, *"Use, follow the CMO provisions on program administration"*.

Consequently, the administrators suggested three common concerns for consideration regarding possible revisions on the policies and standards for the BSEd-Math curriculum in the near future:

1) *Continuing faculty development.* As mentioned by the administrators, *"SUC-TEIs should encourage faculty members to pursue their studies in mathematics education and send mathematics teachers to conferences, seminars, trainings and workshops"*. Professional development activities of the faculty should focus on mathematics content as well as teaching strategies."
2) *Addressing curriculum concerns.* SUC-TEIs need to *"check pre-requisites in all mathematics subjects"* and *"consider the K-12 mathematics framework in designing the curriculum for pre-service mathematics teachers"*.
3) *Providing administrative support.* This can be in the form of scholarship grants, financial support and other privileges for continuing faculty development as well as funding for library resources and laboratory facilities.

These concerns are stipulated in the implementing rules and regulations of the CHED memorandum order, and are included in the indicators of the accreditation instruments by AACCUP.

As revealed by the administrators, problems encountered in the implementation of the Revised BSEd-Math curriculum in their respective institutions include problems in the administration, faculty and resources. Specifically, change in the leadership and management of the College of Education during the period of implementation of the Revised Curriculum was experienced in the three institutions which demonstrated late adoption of the Revised BSEd-Math curriculum.

As part of their preliminary actions in implementing the revised curriculum, linkages with other agencies such as CHED and consultation with other institutions and organizations were also mentioned by administrators of middle-performing and high-performing institutions which demonstrated prompt adoption. On the other hand, these were not mentioned in the low-performing institution which adopted the revised curriculum later than the other institutions.

Institutional adoption of a new curriculum is a management decision that necessitates coordination, participation and cooperation of various stakeholders. Stakeholders should have adequate knowledge and participation in the planning and implementation of the Revised BSEd-Math Curriculum. This was supported by responses of mathematics teacher educators in the middle-performing and high-performing institutions with early adoption of the revised curriculum. In contrast, there was less knowledge and participation of stakeholders as mentioned by mathematics teacher educators in the low-performing institution which demonstrated late adoption. Hence, situations in the teacher education institutions such as leadership, communication, management of resources, and other related issues and concerns may have caused the prompt or delayed implementation of the curriculum adapted by the institutions.

Strict adherence to the policies and minimum requirements of the Revised BSEd-Math curriculum is highly encouraged among state and local teacher education institutions. However, only the Level IV institution and Center of Excellence for Teacher Education together with the two other first state universities in Region III strictly complied with the general education and specialization components of the Revised BSEd-Math Curriculum. In terms of faculty and resources, these institutions have the greatest capability to offer all general education and specialization subjects in the CHED Model Curriculum. Two of these three institutions have a pool of qualified mathematics faculty in the College of Arts and Sciences who handle the mathematics subjects in BSEd-Math. The other institution offers BSEd-Math only in its flagship campus for teacher education.

The seven institutions with high levels of compliance are also the institutions with higher ratios of budget allocation to number of campuses. The three institutions with low levels of compliance have also the smallest ratios of budget allocation to number of campuses. Hence, the number of qualified and trained faculty as well as the availability and adequacy of resources are important factors considered by stakeholders in the choice of mathematics subjects included in the revised BSEd-Math curriculum adapted by their respective institutions.

Decision on the description, number of units, and content of mathematics subjects in the revised curriculum relied much on the actions and recommendations spearheaded by the dean, the head of the mathematics department, and other members of the committee on curriculum planning and development. In the interviews, the administrators and mathematics faculty of middle-performing and high-performing institutions which demonstrated high levels of compliance and innovation described their participation as members of the curriculum committee from the review and planning to the implementation of the revised curriculum in their respective institutions. These administrators include a dean with a Ph.D. degree in mathematics education, a dean with a master's degree in mathematics education and an Ed.D. degree in educational management, and two mathematics coordinators with masters degrees in mathematics education. Three mathematics teacher educators who mentioned membership in the curriculum committee also have masters degrees in mathematics education.

Institutional adaptation also involved various innovations in the revised curriculum adapted by the institutions. Degree of innovation in the adapted curriculum was determined by the number of changes or modifications made by institutions on the CHED Model Curriculum such as increasing the number of units, adding subjects, replacing subjects, or combining subjects. The institutions which demonstrated high innovation include the three youngest and two century-old state institutions in the Region which are the last and the first, respectively, to offer mathematics specialization in the secondary teacher education program. Institutions with low innovation include five century-old institutions and among the first to offer mathematics specialization. Again, factors other than historical background could explain high innovation among both the young and the century-old institutions.

The comparative analysis revealed that institutions with lower levels of compliance have done more innovations than the institutions with high compliance with the CHED Model curriculum. Those with low compliance have made more changes and modifications to the model curriculum. These include the institutions whose mathematics teachers mentioned their minimal participation in the BSEd-Math curriculum revision and their being overloaded. These are the institutions where there was more complaint about lack or inadequate number of books and references, technologies, and resources for instruction as mentioned by administrators, teachers and students. On the other hand, institutions which strictly complied with the offering of recommended subjects made no alterations while those with high levels of compliance have done minimal changes to the list of subjects. These are the institutions with an adequate number of qualified mathematics faculty who handle the mathematics subjects in the BSEd-Math curriculum. These also include the institutions whose teachers indicated more knowledge and participation in the curriculum revision, and where there is minimal or no complaint about problems on books, facilities, and resources from administrators, teachers, and students. Hence, these factors which are negatively associated with degree of innovation may also be categorized under leadership and management of institutions, number of qualified and well-trained faculty to handle the required mathematics subjects, availability and adequacy of resources, and knowledge and participation of stakeholders in the decision-making process.

Combined factors of curriculum adaptation at the institutional level.

Summarized in Table 28 are the factors of curriculum adaptation at the institutional level which were evolved through the use of quantitative and qualitative data. Number of campuses is a negative factor. Initially, this implied that having more campuses hinders timely adoption among institutions in implementing the revised curriculum. Activities related to curriculum planning and revision could delay the implementation of the revised curriculum especially if the BSEd program is also offered in the other campuses. Meanwhile, structural setup of state TEIs in offering the mathematics courses is a positive factor for adoption time, ensuring availability of qualified MTEs to handle the mathematics courses. Moreover, the implementation of the revised curriculum entails additional budget for the hiring and training of faculty, purchase of additional books and references, as well as upgrading of instructional facilities and laboratory equipment.

Table 28

Institutional Factors of Curriculum Adaptation

<table>
<tr><th>Extent of Adaptation</th><th>Factors Inferred from Quantitative Data</th><th>Factors Drawn from Qualitative Data</th></tr>
<tr><td>Time of Adoption</td><td>Number of campuses (-)
Structural setup (+)</td><td rowspan="3">Leadership of administrators
Linkages with other agencies
Stakeholder knowledge and participation
Number of qualified and trained faculty
Availability and adequacy of resources</td></tr>
<tr><td>Level of Compliance</td><td>Budget allocation (+)
Number of accredited programs (+)
BSEd program accreditation level (+)</td></tr>
<tr><td>Degree of Innovation</td><td>SUC level (-)
Budget allocation (-)</td></tr>
</table>

+ positively related factors *- negatively related factors*

Thus, compliance means satisfying these requirements for effective implementation of the revised curriculum. Budget allocation, number of accredited programs, and BSEd program accreditation level were found to have large positive effects on compliance level. However, budget allocation and SUC level were found to have large but negative effects on degree of innovation. Because degree of innovation was based on the number of changes or modifications made on the CHED model curriculum, it correlates negatively with time of adoption and level of compliance. If the assigned codes were reversed such that fewer changes in the new curriculum means more innovations done in the old curriculum, degree of innovation would be positively correlated with the time it takes the institution to adopt the revised curriculum. The negative factors of degree of innovation would become positive instead.

The analysis revealed a positive correlation between budget allocation and SUC level ($r = 0.80$); and between SUC level and BSEd program accreditation level ($r = 0.54$), as well as number of accredited programs ($r = 0.69$). This is to be expected because the evaluation instrument for SUCs leveling includes quality of instruction and management of resources which are also evaluated using AACCUP program accreditation criteria such as administration, faculty, students, library, and facilities.

Analysis of qualitative data showed recurrent themes concerning these accreditation areas for factors related to institutional adaptation. Based on the problems, actions and recommendations mentioned by the three groups of respondents, structural setup of institutions, 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 time of adoption and level of compliance. These, however, are negatively related with 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).

Interrelated factors based on the quantitative data are crucial to the implementation of the revised curriculum. In the same manner, recurrent themes from the qualitative data provide another way of looking at essential factors in the implementation of the revised BSEd-Math curriculum. Hence, the combined factors obtained quantitatively and qualitatively have a complementary role in providing a more comprehensive understanding of the issues and concerns relative to curriculum adaptation at the institutional level.

Factors of curriculum adaptation at the classroom level. Similarly, at the classroom level, linear regression was used to analyze the relationship of the mathematics teacher educators' qualities to their extent of curriculum adaptation. Likewise, critical comparative analysis was used to draw other factors of curriculum adaptation by the MTEs from the qualitative data.

Mathematics teacher educator qualities as predictors of extent of adaptation. Through simple linear regression, each of the qualities of mathematics teacher educators was used as a predictor for extent of curriculum adaptation at the classroom level. As shown in Table 29, the four selected qualities of MTEs have small to moderate positive effects on extent of adaptation of inquiry-based teaching strategies as indicated by the beta coefficients between 0.2 and 0.5.

Table 29

Linear Regression between MTE Qualities and Use of Inquiry-Based Strategies (n=37)

A. MTE Qualities as Predictors of Adoption Time

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*

B. MTE Qualities as Predictors of Compliance Level

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

C. MTE Qualities as Predictors of Degree of Innovation

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*, $p < 0.05$

In Table 29-A, 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.

As shown in Table 29-B, the beta coefficients between 0 and 0.3 indicate 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.

In Table 29-C, views and practices in inquiry mathematics teaching have a small effect ($\beta < 0.3$), while self-efficacy in teaching and TPCK have a moderate positive effect ($0.3 < \beta < 0.5$) on 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.

Likewise, the results of linear regression between the mathematics teacher educators' qualities and their extent of technology integration are summarized in Table 30.

Table 30

Linear Regression between MTE Qualities and Extent of Technology Integration (n=37)

A. MTE Qualities as Predictors of Adoption Time

MTE Qualities	Adoption Time			
	Beta	r^2	*t(35)*	*p*
Views on Inquiry Teaching	0.14	0.02	1.63	0.11
Inquiry Teaching Practices	0.19	0.04	1.12	0.27
Self-Efficacy in Teaching	0.38	0.14	2.36	0.02*
TPCK	0.46	0.22	3.01	0.01*

B. MTE Qualities as Predictors of Compliance Level

MTE Qualities	Compliance Level			
	Beta	r^2	*t(35)*	*p*
Views on Inquiry Teaching	0.12	0.01	0.45	0.66
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*

C. MTE Qualities as Predictors of Degree of Innovation

MTE Qualities	Degree of Innovation			
	Beta	r^2	*t(35)*	*p*
Views on Inquiry Teaching	0.09	0.01	0.53	0.60
Inquiry Teaching Practices	0.05	0.003	0.29	0.72
Self-Efficacy in Teaching	0.42	0.17	2.62	0.01*
TPCK	0.50	0.25	3.31	0.002*

* *significant*, $p < 0.05$

As shown in Table 30, *views on inquiry mathematics teaching* and *inquiry mathematics teaching practices* also have a small positive effect ($\beta < 0.2$) while *self-efficacy in teaching mathematics* and *TPCK* have a moderate positive effect ($0.3 < \beta < 0.5$) on the three indicators of extent of technology integration. With corresponding p-values less than the 0.05 level, mathematics teacher educators' *self-efficacy* and *technological pedagogical content knowledge* were found to be significant predictors of their extent of technology integration in terms of *adoption time*, *compliance level*, and *degree of innovation*. The corresponding coefficients of determination indicate 14 to 25 percent variation in each of the three indicators of extent of technology integration. Hence, the more confident and knowledgeable the teachers are about teaching mathematics content with technology, the earlier and the more frequently they adopt technology integration in a greater number of their mathematics classes.

On the other hand, 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). Providing better explanation for the teacher educators' extent of curriculum adaptation, however, are self-efficacy (Graham & Weiner, 1996) and TPCK (Koh, Chail, & Tsai, 2014). 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 high degree of innovation in inquiry-based activities but late adoption, low compliance, and moderate innovation in technology integration.

Factors of teacher adaptation inferred from the profile of MTEs. Using the recoded values for extent of adaptation (0 for values less than or equal to 3, and 1 for values greater than 3), the mathematics teacher educators were classified into groups that showed either low or high levels of adaptation. Dichotomous and nominal profile variables for the 37 MTEs were also coded (0 for absence, initial, or low categories; 1 for presence, succeeding, or high categories of the trait or characteristic). The recoded data were cross-tabulated to facilitate analysis across categories and corresponding phi coefficients were computed to assess the degree of linear relationship between the MTEs' profile variables and the three indicators of extent of adaptation in terms of inquiry-based teaching strategies and technology integration. In general, indicators for extent of adaptation in using inquiry-based activities and technology integration have low and insignificant correlations ($r = -0.30$ to 0.20, $p > 0.05$, $n = 37$) with profile variables, except *attendance in trainings* and *conduct of trainings*. Equivalently, this indicates that the mathematics teacher educators typically do not differ much in their extent of adaptation across categories of profile variables such as gender, age, civil status, academic rank, teaching status, highest educational attainment, area of specialization, teacher license, number of years in teaching and in teaching BSEd-Math subjects, and membership in professional association as well as in mathematics associations.

For inquiry-based activities, attendance in pedagogy training as well as conduct of training in technology have low but significant positive correlation with adoption time ($r = 0.41$ and 0.33, $p < 0.05$, $n = 37$) and degree of innovation ($r = 0.35$ and 0.34, $p < 0.05$, $n = 37$). This implies that the teachers who attended training in pedagogy and conducted training in technology usually indicated early adoption and high innovation in the use of inquiry-based teaching activities.

For technology integration, adoption time has low to moderate but significant positive correlation with attendance in technology training ($r = 0.34$, $p < 0.05$, $n = 37$) as well as conduct of training on mathematics ($r = 0.44$, $p < 0.05$, $n = 37$), on teaching ($r = 0.37$, $p < 0.05$, $n = 37$), and on technology ($r = 0.54$, $p < 0.05$, $n = 37$). This means that those who attended training on technology as well as conducted training on mathematics, pedagogy and technology typically indicated early adoption of technology integration in their mathematics classes. Meanwhile, degree of innovation has low to moderate but significant positive correlation with attendance in pedagogy training ($r = 0.36$, $p < 0.05$, $n = 37$), attendance in technology training ($r = 0.40$, $p < 0.05$, $n = 37$), as well as conduct of training in mathematics ($r = 0.37$, $p < 0.05$, $n = 37$), on teaching ($r = 0.35$, $p < 0.05$, $n = 37$), and on technology ($r = 0.58$, $p < 0.05$, $n = 37$). Those who attended and conducted the indicated training were the ones who indicated high innovation in technology integration. On the other hand, only conduct of training in technology was found to correlate significantly with compliance level ($r = 0.40$, $p < 0.05$, $n = 37$). The moderate positive correlation validated the assumption that those who conducted training in technology tend to have high levels of compliance in integrating technology in mathematics classes. Hence, *attendance in pedagogy and technology training* as well as *conduct of training on mathematics, conduct of trainings on teaching,* and *conduct of trainings on technology* are additional factors of curriculum adaptation by mathematics teacher educators at the classroom level.

Factors of classroom adaptation drawn from qualitative data. Critical comparative analysis of open ended-response data from the mathematics teacher educators and stakeholders, observations, and documents also revealed interesting insights about factors associated with curriculum adaptation at the classroom level (Please refer to Appendix J for sample summary tables). Success in the implementation of the BSEd-Math curriculum depends much on how mathematics teacher educators have implemented the revised curriculum in their mathematics classes. Based on the survey data, a greater number and percentage of mathematics teacher educators have *high* levels of adaptation in terms of time of adoption (76%) and degree of innovation (89%) in inquiry-based activities. However, in technology integration, more mathematics teacher educators have *low* levels in the three indicators for extent of adaptation: adoption time (54%), compliance level (87%), and degree of innovation used (65%).

For inquiry-based activities, critical comparative analysis revealed that mathematics teacher educators from the high and low categories of adoption time, compliance level, and degree of innovation typically have the same moderate views and practices in inquiry-based mathematics teaching, high levels of self-efficacy, as well as technological pedagogical content knowledge. The MTEs in the high and low groups in terms of technology integration, also typically have moderate views and practices in inquiry-based mathematics teaching and high-levels of self-efficacy, except for level of compliance. However, the level of TPCK among those with high levels of adaptation is typically higher than for those with low levels of adaptation. Meanwhile, comparative analysis between profiles of the MTEs with high and low levels of adaptation revealed that those who conducted training on mathematics, teaching strategies, and technology also have higher levels of adaptation than those who have not yet conducted a training.

Based on the responses of the stakeholders, a number of institutional factors are also associated with curriculum adaptation by mathematics teacher educators. Other factors related to personal attributes of mathematics teacher educators were also revealed by their responses to the open-ended items of the survey. Teaching philosophies of mathematics teachers with higher levels of adaptation are more inquiry-based than those with lower levels of adaptation. Readiness for new material, strategy or technology is an indication of early adoption while creativity in managing mathematics classes effectively despite limited resources is associated with degree of innovation.

Administration and supervision is one of the many functions of effective leaders. As mentioned by administrators of middle-performing and high-performing institutions where mathematics teacher educators typically have higher levels of adaptation, monitoring of syllabi and observation of classes are interventions done for effective implementation of the revised BSEd-Math curriculum in their respective institutions. In the interview, mathematics teacher educators from these institutions also indicated more knowledge and participation in the implementation of the revised curriculum through consultation and planning meetings, discussions about CMO 30 s. 2004, visiting and linkaging with other institutions, vertical articulation in advanced studies, attendance in seminars and trainings, and related activities. In contrast, for those in the low-performing institution with lower levels of adaptation, responses were limited to information dissemination drive, review, and actual handling of mathematics subjects in the BSEd-Math curriculum. Again, this may be attributed to management and supervisory practices of administrators, dissemination of policies and standards of the revised curriculum, and involvement of the faculty in various professional development activities relative to the BSEd-Math curriculum implementation.

Problems encountered, actions done, and suggestions by the MTEs for effective implementation of the revised BSEd-Math curriculum also provided interesting insights about the factors of curriculum adaptation at the classroom level. Five MTEs confirmed that they encountered problems in teaching mathematics subjects in the revised curriculum. Three mentioned problems that relate to students: "Some students are not dedicated in their line of specialization. . . either have a weak foundation in math or lacked time to rediscover it intensified by external factors such as internet, malls, etc." (HT1). Two teachers wrote that students are not yet prepared for the new mathematics courses (HT3, MT1). Hence, these may imply the need for stricter admission and retention policies as well as a more functional student guidance services.

Two MTEs cited problems encountered in handling content, lessons or topics in mathematics subjects. This is supported by the students' responses which indicated difficulty in some mathematics subjects especially due to problems in course description, arrangement, and scheduling of classes.

One teacher said, "Putting together content and pedagogy, I tend to focus more on content." (LT1). The other teacher wrote: "Some subjects contained chapters/topics that can't be directly found in textbooks/references." (MT2). Incidentally, these are subjects in which the MTEs have limited background, training, and experience.

When asked what they have done so far to effectively carry out the revised curriculum in their mathematics classes, the teacher respondents answered as follows:

- Two teachers centered on *training students* "to explore and think logically" (HT3) and "to think outside the box, encourage them to explore more, and to exert more effort in studying the discipline" (MT1).
- Three teachers cited actions that *focus on course objectives and methodology* through: integration of CHED's objectives in the lessons, facilitative delivery of learning competencies, enrichment activities with more students participation, and integration of technology.
- Two teachers mentioned actions that relate to the mathematics teacher educators themselves and *their role in implementing the revised curriculum*: "I re-studied some of the courses" (LT1), and "Cooperation" (LT2).

These are parallel to the interventions done in the institutions as mentioned by the administrators which include faculty preparation and participation, especially in the review and revision of the curriculum. Subsequently, the MTEs gave suggestions and recommendations for successful implementation of the revised BSEd-Math curriculum.

Four teachers gave suggestions about mathematics teacher educators and the mathematics subjects that they handle:

- "Hire competent faculty to teach full-time in BSEd-Math"
- "Assign mathematics teachers the subjects they teach best"
- "Send teachers to seminars and trainings on mathematics content and teaching strategies with technology"
- "Lessen workloads of teachers for them to fully concentrate in teaching their assigned subjects"

The suggestions of three teachers relate to students and their training as future high school mathematics teachers. One said, *"Although the revised math curriculum has plenty of higher math subjects, students should not forget the basics of math."* (HT3). Another teacher mentioned, *"proper orientation of students. . . to make a difference as future graduates of the revised curriculum"* (HT4). One teacher stressed: *"Make sure that students as future math teachers are masters of the discipline and of the ways to teach."* (MT1).

Students' responses to open-ended questions as well as rating-type questions and checklists on issues and concerns about the implementation of the revised BSEd-Math curriculum also validated and complemented the responses of the administrators and their teachers. As regards what problems the students had met in their mathematics subjects in the BSEd-Math curriculum, seven (22%) students mentioned problems about resources and technology while 17 (53%) reported having met problems about course content, schedule, and duration. Eight (25%) indicated that they did not encounter any problem. The most typical problems reported by students from the low-performing institution were about facilities and resources as indicated in the following responses:

- "There are limited resources for instruction such as books. The room is not well-ventilated that after the class we are sweating all over."
- "The school does not provide technologies like Internet and web technologies."
- "There is a need for graphing calculators which can be used in math classes like trigonometry and linear algebra."

Most typical problems met by students from the middle-performing and high-performing institutions were about course content, schedule and time allotment:

- "The time allotted for the subject is not enough. Time is limited especially when having examinations."
- "lack of time most especially when the semester is about to end. We always extend our time in the discussion."
- "improper scheduling and inappropriate course description of some subjects"
- "Some subjects were put together in one semester and I consider it a problem."
- "one of the problems I met is the difficulty of some subjects. There are some topics which are not clear to me in such a short period of time."
- "improper alignment of pre-requisites in the mathematics curriculum and studying a subject without knowing the pre-requisite topics."

Consequently, the students gave suggestions for effective teaching-learning of mathematics subjects in BSEd-Math. Sixteen (50%) gave suggestions on use of technology integration, 11 (34%) on experiential learning of students, eight (25%) for more effective mathematics teacher educators, and five (16%) each for additional facilities and resources as well as alignment and scheduling of mathematics subjects. Four (13%) did not give any suggestions or recommendations; but indicated satisfaction with their mathematics classes in BSEd-Math.

The most frequent suggestions in the low-performing and high-performing institutions relate to the need for more technology integration in teaching. Overall, suggestions of students from the three categories of institutions imply the need to improve teaching-learning practices in their respective institutions.

For effective teaching-learning of mathematics subjects in the BSEd-Math curriculum, the students suggested the use of technology integration in their mathematics classes:

- "Technologies must be used in actual teaching. These may help the teachers to do their work more easily and the students to learn easily and quickly."
- "Math instructors must often integrate technology in their discussions. It will be more effective than traditional methods of teaching math."
- "Teachers should use technology in delivering the lessons so that students can adapt and know how to present the lesson using technology."
- "Use more advanced technology that will help to mold us to be globally competitive math teachers in the future."

Focus on experiential learning and inquiry-based teaching-learning opportunities in their mathematics classes also emerged as common suggestion of students from the three SUC-TEI categories:

- "Teachers must show students that math is fun."
- "Teach math in a way that students can feel it is a part of real life."
- "Let the students experience the teaching process in their field of specialization."
- "Make the class more proactive and participatory so that everyone is engaged with math. Provide opportunities for students to speak out their questions, suggestions, and recommendations with regard to the lesson."

- "Students should have more experience in facilitating the class as early as now so that by the time they are already in the field, they will be expert as professional teachers."

Other suggestions address problems, issues and concerns about the description, offering, arrangement and schedule of mathematics subjects in the BSEd-Math curriculum:

- "Make sure that the course description and content of the subjects are correct."
- "They should add more interesting subjects like calculus."
- "Curriculum developers should consider the arrangement of the subjects being offered and focus on the alignment of pre-requisite subjects in math."
- "Study the list of subjects that must come first in the curriculum."
- "Schedule the subjects properly. Do not schedule difficult subjects like Abstract Algebra in a 3-hour class session."

Students also want additional references and resources as well as improvements in the instructional facilities and equipment:

- "Provide some references that would help students to learn new concepts, techniques in solving mathematical problems… and any technologies that can help in teaching for easy understanding."
- "Provide computer laboratory for subjects in math which involve technology application. Provide a room which can be used in math subjects with enough materials and equipment for mathematical applications."
- "Instructors will be more effective if the administration will provide and

support the facilities and equipment needed in any subject especially integration of technology."

The foregoing responses by the MTEs and their students elaborated more on the responses by the administrators regarding the roles of the faculty, continuing faculty development, curriculum concerns, resources and technology, and support from the administration. However, looking more closely at the survey data, a higher degree of innovation was demonstrated by the mathematics teacher educators who already taught mathematics subjects like Linear Algebra ($M_{\text{taught}} = 2.75$, $M_{\text{not taught}} = 2.46$) and Abstract Algebra ($M_{\text{taught}} = 3.10$, $M_{\text{not taught}} = 2.25$) while those who have not taught the said subjects typically demonstrated low innovation. These subjects in the revised BSEd-Math curriculum were considered by a study (Pulmones et al., 2008, p. 76) to have higher levels of cognitive demand, requiring cognitive skills up to problem solving, application, proving, and abstraction (rigor). Higher levels of innovativeness were also shown by those who already taught Advanced Statistics ($M_{\text{taught}} = 3.06$, $M_{\text{not taught}} = 2.27$) and Technology in Mathematics ($M_{\text{taught}} = 3.41$, $M_{\text{not taught}} = 2.29$). Teaching these subjects typically require the use of technology, implying that it takes a highly adaptive mathematics teacher with a high level of self-efficacy and TPCK and other related qualities to be able to handle subjects usually considered cognitively tasking by others.

Combined factors of curriculum adaptation at the classroom level. The combined factors associated with extent of curriculum adaptation by mathematics teacher educators in their mathematics classes which were identified through analyses of quantitative and qualitative data are summarized in Table 31.

Table 31

Factors of Curriculum Adaptation at the Classroom Level

Extent of Adaptation	*Factors Inferred from Quantitative Data*	*Factors Drawn from Qualitative Data*
Adoption Time	Self-efficacy (t) TPCK (i, t) Attendance in pedagogy training (i) Attendance in technology training (t) Conduct of math training (t) Conduct of pedagogy training (t) Conduct of technology training (i,t)	Philosophy in teaching math Readiness for new material, strategy, or technology Creativity to manage math classes despite limited resources Involvement in professional development activities Administrative support Availability of resources External linkages Cognitive demand of math subjects
Compliance Level	Self-efficacy (t) TPCK (t) Conduct of technology training (t)	
Degree of Innovation	Self-efficacy (i,t) TPCK (i,t) Structural setup (t) Attendance in pedagogy training (i, t) Attendance in technology training (t) Conduct of math training (t) Conduct of pedagogy training (t) Conduct of technology training (i,t)	

i inquiry-based activities *t technology integration*

Two of the four characteristics of MTEs which were explored in this study were found to be significant predictors of their extent of adaptation to the BSED-Math curriculum. Results of the quantitative data analysis revealed that self-efficacy in teaching mathematics as well as technological pedagogical content knowledge have significant effects on teachers' extent of curriculum adaptation in terms of inquiry-based activities and technology integration (Tables 29 and 30). These supported the findings of Graham & Weiner (1996) and Koh, Chail, & Tsai (2014) that self-efficacy and TPCK are factors in inquiry-based teaching and technology integration, respectively. Teachers' views and practices in inquiry teaching, however, have no significant effect on their extent of adaptation. 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. This could be explained by the eclectic views and practices of the mathematics teachers which focused on both traditional and inquiry teaching, similar to the findings of Handal (2003) and other local studies much as those of Limjap et al. (n.d.), and Villena (2004).

Other factors derived include attendance of mathematics teacher educators in trainings and seminars in teaching strategies and in technology as well as conduct of trainings and seminars in mathematics, in teaching strategies, and in technology. These factors could either promote or inhibit integration of technology into teaching and learning (Handal et al., 2013).

In relation to the study of ChanLin et al. (2006), factors inferred from qualitative data such as philosophy in teaching mathematics, creativity in managing classes, and readiness for new material, strategy, or technology may be described as personal factors. Involvement in professional development activities and administrative support may be classified as social factors while availability of resources is an environmental factor. On the other hand, level of cognitive demand of mathematics subjects (Limjap et al., n.d.) may be considered as a curricular factor.

Similarly, factors obtained from the quantitative data could also be classified under the same categories of factors which are borne out by the qualitative data. Self-efficacy and TPCK may be considered as personal factors. Meanwhile, attending as well as conducting seminars and trainings and related professional development activities could fall under social factors. Together, the combined factors obtained quantitatively and qualitatively are all positively related to promptness, compliance, innovativeness, and other concerns about mathematics teacher educators' use of inquiry-based teaching and technology integration in the mathematics classrooms.

Therefore, based on the combined results and findings about the extent of curriculum adaptation at the institutional and classroom level as well as the underlying factors derived from the quantitative and qualitative data, a re-conceptualized framework of the study is hereby presented in Figure 5.

Five of the six institutional characteristics (*number of campuses*, *SUC level*, *budget allocation*, *number of accredited programs*, and *BSED accreditation level;* except *BSEd program compliance*) are retained in the new framework, with the addition of structural setup as institutional factor. Included are five new institutional and classroom factors (*administrative support*, *professional development activities*, *stakeholder participation*, *availability of resources*, and *external linkages*) that were obtained from the qualitative data.

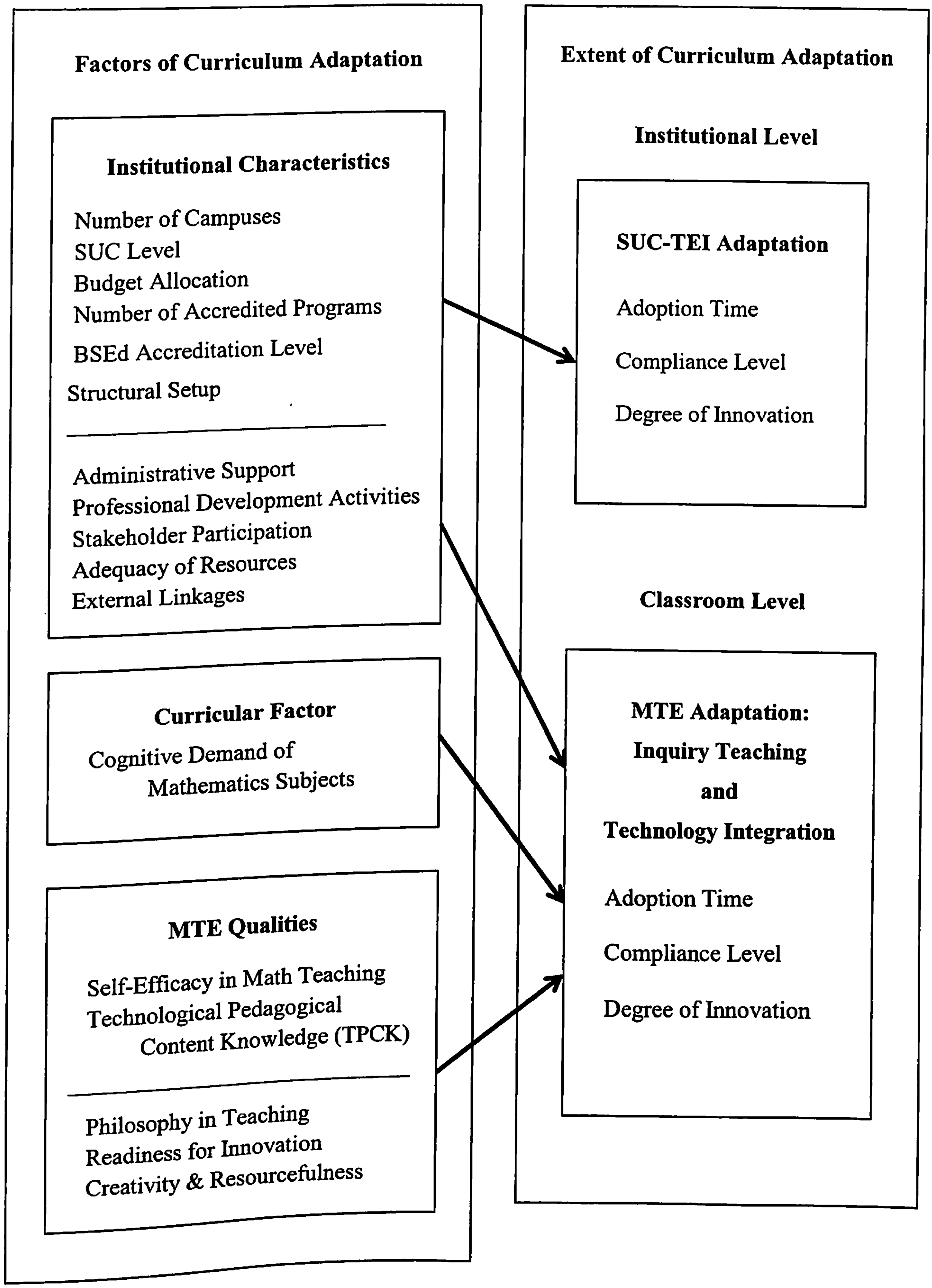

Figure 5. Re-Conceptualized Framework of Study

Two of the four MTE qualities (*self-efficacy* and *TPCK,* except *views on inquiry mathematics teaching* and *inquiry mathematics teaching practices*) remained, with the addition of three factors (*philosophy in teaching, readiness for innovation*, and *creativity and resourcefulness*) derived from the qualitative data. Meanwhile, *cognitive demand of mathematics subjects* is also included as a curricular factor. The five institutional factors derived from recurrent themes in the qualitative data are also factors of curriculum adaptation at the classroom level. The combined factors of institutional and MTE adaptation can be further examined through multiple linear regression using a larger sample size of quantitative data or through a more in-depth qualitative study.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter provides a brief overview of the study from the statement of the problem and procedures to the summary of results and findings. Conclusions drawn and their implications as well as recommendations are presented thereafter.

Summary

In today's fast-changing world, curriculum change has become inevitable for schools and teachers as they prepare the citizens of society to be ready to adapt to global trends and standards, especially through science and mathematics education. With the series of changes in the basic education curriculum (SEDP, BEC 2002, SEC 2010, K to 12) there is a need to look into the preparation of high school mathematics teachers in particular because of several revisions in the area of mathematics from spiral to linear arrangement and vice-versa, including integration of technology. Teacher education institutions, therefore, should make their curricular program offerings responsive to latest developments in basic education, especially in compliance with the Memorandum Order issued by the Commission on Higher Education (CHED) on the Revised Policies and Standards for Undergraduate Teacher Education Curriculum (CMO 30, s. 2004).

This mixed-methods research combined qualitative and quantitative approaches to explore how 10 state teacher education institutions in Central Luzon (Region III) adapted the revised Bachelor of Secondary Education-Mathematics (BSEd-Math) Curriculum for pre-service mathematics teachers. Specifically, the study sought to determine the extent of adaptation of the revised BSEd-Math curriculum by the institutions and by the mathematics teacher educators in their mathematics classes, based on the perceptions of the administrators, teachers and students, and related sources of data. Underlying factors of curriculum adaptation at the institutional and classroom levels were inferred from the institutional characteristics and teacher qualities, and drawn from the qualitative data. From the review of related literature and studies, the criteria used in assessing the extent of curriculum adaptation at both levels were adoption time, compliance level, and degree of innovation. Pre-survey data were collected during the Second Semester of School Year 2011-2012. Actual data gathering and inquiry continued during the first semester of the next school year and ended in December 2012.

Survey data were collected from 10 administrators composed of deans and coordinators, and from 37 (80% of the total number of) mathematics teacher educators handling mathematics subjects in BSEd-Math. For the follow-up inquiry, four of the 10 TEIs were selected from the identified high-performing (2), middle-performing (1), and low-performing (1) categories of institutions based on their corresponding numbers of BSEd-Math graduates and percentages of LET passers. Additional data were gathered through interviews with eight mathematics teacher educators and 32 students selected purposively from each year level with mathematics specialization subjects, classroom observations by six administrators who observed BSEd-Math classes of 21 mathematics teacher educators, and related documentary sources.

Survey questionnaires with 5-point rating scale items and open-ended questions, interview guides, and classroom observation checklists were designed by the researcher, validated for content by three mathematics experts, and tried out in two satellite campuses of a multi-campus state university in Region III. Rating scales were subjected to reliability analysis and were found to have acceptable Cronbach alpha coefficients.

Triangulation was used to ensure credible responses and authentic information from the respondents and sources of data.

The qualitative data were content analyzed for meaningful description and comparison across institutions. The data were then coded using appropriate scoring rubrics for quantitative treatment. Descriptive statistics as well as linear regression and correlation were used in analyzing the quantitative data. Critical content analysis and comparative analysis of the qualitative data were also done to explore the underlying factors of curriculum adaptation at the institutional and classroom levels. Subsequently, the results of quantitative data analysis and the findings from the qualitative data were integrated.

The 10 state teacher education institutions in Central Luzon offering the BSEd-Math curriculum consisted of 7 state universities and 3 state colleges. These state institutions of higher learning were former trade or agricultural schools, established more than a decade or a century ago. Situated in one or several campuses in their respective provinces, these institutions have been offering the mathematics specialization in the teacher education program for the last one to five decades. With SUC categories from Level II to Level IV by the CHED and DBM, these institutions have been receiving up to more than 200 million PhP annual budget allocations from the national government. At most 32 academic programs of these institutions have already been accredited by the Accrediting Agency of Chartered Colleges and Universities of the Philippines (AACCUP), with the BSEd program typically accredited up to Level III re-accredited status.

From 2007 to 2011, the biggest numbers of BSEd-Math graduates of these SUC-TEIs were from the former trade schools while the smallest numbers were from the former agricultural schools. For the same period, the biggest numbers of BSEd-Math graduates licensed by the Professional Regulations Commission were passers from three state universities, while the smallest numbers were from the three state colleges and one state university. Consequently, six institutions were categorized as high-performing while three others were middle-performing. Only one was low-performing.

The extent of curriculum adaptation by the institutions was based on the pre-survey data, the responses of the administrators in the interview, data from the BSEd-Math curriculum adapted by the 10 institutions, and related documents. The state TEIs surveyed typically started offering the revised curriculum during the school year 2006 to 2007. Typical compliance done by the institutions was offering the minimum required number of units but not using all course descriptions of the mathematics general education and specialization subjects in the CHED Model Curriculum. Typically, they had done two types of modifications in the required mathematics subjects by increasing the number of units, adding other subjects, replacing a suggested subject by another subject, or combining two or more required subjects. Based on the computed mean ratings from the corresponding coded data, the 10 state TEIs demonstrated prompt adoption, high level of compliance, and moderate degree of innovation.

At the classroom level, the mathematics teacher educators typically held eclectic views that put equal emphasis on traditional and inquiry-based teaching. Also, they indicated that their teaching practices are characterized by both traditional and inquiry-based teaching. Equivalently, the computed mean ratings from their coded responses indicated moderate views and practices in inquiry-based teaching. Generally, they indicated high levels of self-efficacy to do each indicated teaching task in traditional as well as inquiry-based teaching. They also indicated high levels of technological, pedagogical, and content knowledge.

The MTEs typically indicated early adoption, moderate compliance, and high innovation in the use of inquiry-based teaching activities. However, they typically indicated late adoption, low compliance, and moderate innovation in technology integration.

The students supported the mathematics teachers' self-reported ratings of high innovation in the use of inquiry-based activities but low to moderate innovation in technology integration in their mathematics classes as indicated by the corresponding mean ratings for inquiry-based activities and technology integration. Administrators, however, indicated very positive mean ratings for the teachers' use of inquiry-based activities and technology integration. Nevertheless, the favorable ratings by the administrators categorically asserted the MTEs' extent of curriculum adaptation at the classroom level.

As indicated by the results of linear regression, number of campuses was found to be a negative factor while budget allocation, number of accredited programs, and BSED program accreditation were found to be positive factors with large effects on extent of adaptation of the BSEd-Math curriculum at the institutional level. However, only number of accredited programs was found to be a significant predictor of compliance level. Meanwhile structural setup of the state TEIs in offering the mathematics courses was found to be a factor of adoption time. Based on the critical content analysis and comparative analysis of the qualitative data from the stakeholders and documents, *Leadership and administrative support*, *Linkages with other agencies*, *Knowledge and participation of stakeholders*, *Number of qualified and trained faculty*, and *Availability and adequacy of resources* were the recurrent themes identified as important factors in the implementation of the BSEd-Math curriculum adapted by the institutions.

Meanwhile, the results of linear regression indicated that self-efficacy as well as technological pedagogical content knowledge were the two characteristics of mathematics teacher educators found to have positive and significant effect on their extent of curriculum adaptation at the classroom level. *Attendance in trainings* and *Conduct of trainings* in mathematics, pedagogy, and technology were also found to be positive factors associated with the MTEs' time of adoption, level of compliance and degree of innovation in inquiry teaching and technology integration in the BSEd-Math classes. From the critical content analysis and comparative analysis of the qualitative data from the stakeholders (teachers, students, and administrators) and related documents, higher levels of adaptation were found to be associated with inquiry-based *philosophy in teaching mathematics*, readiness for new material, strategy or technology, and Creativity in managing classes. Also, the recurrent themes at the institutional level like *Involvement in professional development activities*, *Administrative support*, and *Availability of resources*, as well as *Cognitive demand of mathematics subjects* were found to be associated with the MTEs' time of adoption, level of compliance, and degree of innovation in their BSEd-Math classes.

Conclusions

Based on the results and findings of the study, the following conclusions can be drawn for the population of state teacher education institutions offering BSEd-Math in Central Luzon:

1. The state TEIs offering the BSEd-Math curriculum have the following typical characteristics:
   1.1 They are multi-campus state universities with several campuses in their respective provinces.
   1.2 They are state institutions of higher education recognized by national government agencies, especially in terms of quality and relevance of instruction.
   1.3 They receive corresponding annual budget allocations for their operation as national agencies under the Office of the President as stipulated in the General Appropriations Act.
   1.4 They have a number of programs accredited by the Accrediting Agency of Chartered Colleges and Universities in the Philippines.
   1.5 Their BSEd programs have re-accredited status, comparable to the best in the country.
   1.6 They are highly compliant with the minimum requirements set by CHED for program administration of the BSEd curriculum.
2. The mathematics teacher educators handling the mathematics subjects in the BSEd-Math curriculum have the following typical qualities:

2.1 They have eclectic views on teaching with emphasis on both traditional and inquiry-based teaching of mathematics.

2.2 They have eclectic teaching practices characterized by both traditional and inquiry-based teaching of mathematics.

2.3 They have high levels of self-efficacy in teaching mathematics.

2.4 They have high levels of technological pedagogical content knowledge in teaching mathematics.

3. The SUC-TEIs typically manifest extent of curriculum adaptation through:

   3.1 prompt adoption of the Revised BSEd-Math curriculum;

   3.2 high compliance with the minimum required number of units in the revised curriculum;

   3.3 moderate innovation done on mathematics subjects in the CHED model curriculum through modification, replacement, combination, or addition of subjects or units.

4. The mathematics teacher educators from the state TEIs typically manifest extent of adaptation of the BSEd-Math curriculum in their mathematics classes through:

   4.1 early adoption of inquiry-based teaching strategies but late adoption of technology integration;

   4.2 moderate compliance with the use of inquiry-based teaching strategies but low compliance with technology integration; and

   4.3 high innovation in the use of inquiry-based teaching strategies but moderate innovation in technology integration.

5. Factors of curriculum adaptation by the SUC-TEIs at the institutional level are described as follows:

    5.1 Number of campuses has a large but no significant effect on the time of adoption of the BSEd-Math curriculum.

    5.2 Number of accredited programs has a large and significant effect while budget allocation and BSEd program accreditation level have large but insignificant effects on compliance level.

    5.3 SUC level and budget allocation have large but insignificant effects on degree of innovation made.

    5.4 Structural setup in offering the mathematics courses is a positive factor of institutional adoption time.

    5.5 Indicators of institutional capability such as leadership and administrative support, stakeholders' knowledge and participation, and linkages with other agencies are important factors considered in implementing the revised BSEd-Math curriculum adapted by the institutions. These provide some explanation for the time of adoption, level of compliance, and degree of innovation in the revised BSEd-Math curriculum adapted by the state TEIs.

6. Factors of curriculum adaptation by the MTEs at the classroom level are described as follows:

    6.1 MTEs' self-efficacy in teaching mathematics has a large and significant effect on their adoption time in inquiry teaching and technology Level of integration, as well as on compliance level and degree of innovation in technology integration.

6.2 MTEs' technological pedagogical content knowledge has a large and significant effect on their adoption time and degree of innovation in both inquiry teaching and technology integration, and on compliance level in technology integration.

6.3 Attendance in trainings as well as conduct thereof (in mathematics, pedagogy, and technology) are positive factors associated with the MTEs' adoption, compliance and innovation in inquiry teaching and technology integration.

6.4 Other personal traits of the MTEs such as philosophy in teaching, readiness for innovation, creativity in managing classes as well as involvement in professional development activities, administrative support, and availability of resources are also important factors associated with the MTEs' extent of curriculum adaptation.

6.5 Cognitive demand of mathematics subjects is also an important curricular factor for the mathematics teacher educators to effectively adapt and implement curriculum innovation in their BSEd-Math classes.

Recommendations

From the results and findings of the study, the following recommendations are presented for improving policies and practices toward effective implementation of the BSEd-Math curriculum at the institutional and classroom levels.

The state teacher education institutions should intensify development efforts in quality assurance and accreditation of the BSEd-Math program and other teacher education programs for continuous upgrading of institutional capabilities for efficient and effective management of resources, delivery of quality instruction to students, and other related mandated functions for the clientele in the service communities. Specifically, the state TEIs can:

1. maintain an active and participatory decision-making process involving representatives from various groups of stakeholders, especially on matters concerning the welfare of the students, the faculty, and the curriculum. This would ensure that the concerned stakeholders are knowledgeable about the plans and actions before their actual implementation. After all, transparency in governance is expected of all state TEIs as government agencies under the Office of the President of the Republic.
2. strengthen linkages with external agencies such as the Commission on Higher Education, Professional Regulation Commission, Centers of Excellence and Development, other TEIs, and other organizations as regards the offering or implementation of new or revised curricular programs for early adoption, compliance, and innovation or improvement of existing programs. More than ever, the institutions need to work together to resolve issues and concerns regarding the K to 12 curriculum implementation and the ASEAN integration.
3. sustain faculty development through strict recruitment policies based on actual need and merit, scholarships for advanced degrees, fellowships and exchange programs, and other professional development activities such as seminars, trainings and conferences in the areas of mathematics, pedagogy, and technology. Continuing faculty development would guarantee an adequate number of qualified and trained faculty members to teach the required courses

in the curriculum, and thereby contribute to prompt adoption and compliance with the requirements of the revised curriculum. Too many modifications in the required subjects can be minimized if there are available teachers for the said subjects. Faculty overloading and handling of classes by less qualified teachers can also be prevented.

4. prioritize the procurement and upgrading of facilities, laboratories, instructional media and equipment. The availability and adequacy of the needed resources would also facilitate timely adoption and compliance with the requirements of the revised curriculum.

As primary agents of curriculum implementation at the classroom level, the mathematics teacher educators must have the necessary qualities and qualifications to efficiently and effectively implement the revised BSEd-Math curriculum in their classes. Specifically, the MTEs can:

1. reflect on their views and practices, self-efficacy, technological pedagogical content knowledge, and other personal traits and qualities like philosophy in teaching, readiness for innovation, and creativity in managing classes. Becoming reflective teachers would keep the MTEs motivated as they perform their critical role in implementing the BSEd-Math curriculum through inquiry-based teaching and technology integration in the mathematics classroom with promptness, compliance and innovation.
2. be actively involved in professional development activities through advanced studies, seminars, trainings, conferences, membership in professional organizations, and related opportunities in mathematics, teaching, and

technology. Continuous upgrading of qualifications, skills, and competencies could facilitate prompt adoption, compliance, and innovation among the MTEs as they adapt inquiry-based teaching with technology in their classes. In the end, not only are they preparing and mentoring the future mathematics teachers in basic education but also contributing to the improvement of the quality of mathematics education for the next generations.

3. be ready to communicate concerns with the administration, faculty, students, and other stakeholders in writing or through active participation during meetings, consultations, action planning, and decision-making on matters concerning their role as MTEs. This would help identify and resolve issues and problems with the administration, faculty and students, curriculum and instruction, library and instructional media, laboratories and facilities, and other related resources of the institutions.

The CHED, the Centers of Excellence in Teacher Education, and other recognized national and regional training centers and institutions can:

1. continue extending assistance to the TEIs and provide more opportunities for curriculum improvement, faculty development and training especially in mathematics, teaching, and technology; and
2. spearhead in revising the curriculum for BSEd-Math and other higher education programs in order to make the curricular offerings globally competitive, especially with the upcoming ASEAN integration.

Considering the limitations as well as the problems encountered in the conduct of this study, the following recommendations are presented for further research:

1. conduct a follow-up study in the same institutions using a longitudinal design to determine if there will be changes in the extent of curriculum adaptation by the MTEs at the classroom level with the assumption that over time they gain more teaching experience and exposure to new technologies.
2. replicate the study using the same mixed-methods research design in other regions of the country to validate the results and the findings of the study. The use of another related mixed-methods design.
3. increase the sample size and apply random sampling, whenever possible, in the selection of research sites and respondents in order to address the generalizability and external validity of the results of the study.
4. use more objective measures other than self-ratings like teacher tests and classroom observation for more reliability and credibility of information and findings.
5. explore other variables in a future study like effectiveness of downloadable mobile technology applications in improving students' skills and competencies in mathematical investigation and modeling, as well as the role of social media in mathematics teaching and possible effects on preservice peer learning.
6. explore other sub-variables under curricular factors like scope and topic coverage of prescribed mathematics subjects which can also be used in the assessment of adoption time, compliance level, degree of innovation, and other related indicators of extent of curriculum adaptation.

7. conduct studies on curriculum adaptation in other disciplines or other levels of education to find out if results and findings will yield similar or related factors.

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APPENDIX A

Republic of the Philippines
RAMON MAGSAYSAY TECHNOLOGICAL UNIVERSITY
SAN MARCELINO CAMPUS
San Marcelino, Zambales

February 15, 2012

2/17/2012
Dr. Nael Peters
Dean, I Educ
For your information & appropriate action / favorable consideration.
Thank you.

Dr. Max P. Guillermo
President
Tarlac College of Agriculture
Camiling, Tarlac

Sir:

Greetings!

I am a faculty member of Ramon Magsaysay Technological University pursuing Ph.D. in Education (Mathematics Education) at the UP Open University. I am presently preparing my dissertation entitled ***Variations in Curriculum Adaptation in Mathematics Teacher Education in Region III.*** My study will explore how state teacher education institutions have adapted the revised Bachelor of Secondary Education (Mathematics) curriculum using a combination of qualitative and quantitative research approaches.

In this connection, may I request permission to gather preliminary data from your school through the Office of the Registrar or the Dean of the College of Education. Data on graduates, their performance in the Licensure Examination for Teachers (LET) and related information will be used in selecting four SUCs in the Region as research sites for the study.

I would also like to request permission to obtain data on the performance of your BSED (Mathematics) graduates from the Professional Regulations Commission (PRC) in case some said data are not yet available in your institution. Rest assured that all information will be held with utmost care and confidentiality.

Thank you very much for the much needed help and kind assistance.

Very truly yours,

FERDINAND V. TAMORIA
Researcher

Noted:

FELICIANO S. ROSETE, Ph.D.
University President

University of the Philippines Open University
FACULTY OF EDUCATION
Los Baños, Laguna 4031

March 6, 2012

Dr. Mariano C. De Jesus
President
Bulacan State University
City of Malolos, Bulacan

Sir:

Greetings!

I am a faculty member of Ramon Magsaysay Technological University pursuing Ph.D. in Education (Mathematics Education) at the UP Open University. I am presently working on my dissertation entitled ***Variations in Curriculum Adaptation in Mathematics Teacher Education in Region III.*** My study will explore how state teacher education institutions have adapted the revised Bachelor of Secondary Education (Mathematics) curriculum using a combination of qualitative and quantitative research approaches.

In this connection, may I request permission to conduct research in your institution? Respondents are the Dean of Teacher Education, BSED Program Chair/Coordinator, Faculty members handling the mathematics subjects in the BSEd (Mathematics) curriculum, and selected BSEd (Mathematics) students. Data will be gathered using documentary sources, survey questionnaires, interviews, and classroom observations. Rest assured that all data and results will be held with utmost care and strict confidentiality.

Your much needed help and support will be highly appreciated.

Very truly yours,

FERDINAND V. TAMORIA
Researcher

Noted:

MILAGROS D. IBE, Ph.D.
Professor Emeritus, UP College of Education
Research Adviser

Approved:

03.14.12

University of the Philippines Open University
FACULTY OF EDUCATION
Los Baños, Laguna 4031

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Date

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Sir:

Greetings!

I am a faculty member of Ramon Magsaysay Technological University pursuing Ph.D. in Education (Mathematics Education) at the UP Open University. I am presently working on my dissertation entitled ***Variations in Curriculum Adaptation in Mathematics Teacher Education in Region III.*** My study will explore how state teacher education institutions have adapted the revised Bachelor of Secondary Education (Mathematics) curriculum using a combination of qualitative and quantitative research approaches.

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Your much needed help and support will be highly appreciated.

Very truly yours,

FERDINAND V. TAMORIA
Researcher

Noted:

MILAGROS D. IBE, Ph.D.
Professor Emeritus, UP College of Education
Research Adviser

APPENDIX B

Contrast Between School Mathematics and Inquiry Mathematics Traditions
(Bernardo, 2002)

Dimension	*School Mathematics Tradition*	*Inquiry Mathematics Tradition*
Mathematics Knowledge	Formalized mathematics as collection of facts and procedures	Mathematics as a mode of inquiry and problem solving
Mathematical learning activities	Mastering and replicating mathematical procedures and operations	Exploration, discovery, conjecturing, argumentation, proving, problem posing, problem solving and collaboration
Classrooom interactions/ Discourse	Teacher-controlled, initiation-reply-evaluation pattern	Discussion and negotiations among students and between students and teacher
Role of learner	Passive recipient of information (mathematical facts and procedures) who should master the execution and use of the same	Active constructor of mathematical meanings and processes (i.e. inquirers and problem solvers)
Role of teacher	Authority and transmitter of of mathematical knowledge	Facilitator of students' inquiry and learning
Role of textbook	Authority of mathematical knowledge	Resource and stimulus for students' inquiry and problem solving
Indicator of student learning	Ability to follow procedural instructions to obtain correct answer	Ability to explain and justify actions on mathematical objects

APPENDIX C

PRESURVEY AMONG STATE TEACHER EDUCATION INSTITUTIONS IN REGION III

(May be accomplished by the Registrar and/or Dean of the College of Education)

Kindly provide the following data and information about the ***BSED (Mathematics) Curriculum*** *in your* ***Main Campus*** *or* ***Flagship Campus in Teacher Education****. These will be of great help in selecting SUCs in the Region as research sites for the study.*

1. Name of SUC: ______________________________
2. Dean of the College of Education (main/ flagship campus): ______________________________
3. Contact Number: ______________________ Email: ______________________
4. Excerpts from Board Resolution/Minutes of Meeting on the Approval and Implementation of the Revised BSED (Mathematics) Curriculum as per CMO 30, s. 2004: ______________________________
____
____
5. Number of Mathematics Faculty Teaching Math Subjects in BSED: ______ Other Courses: ________
6. List of Mathematics Subjects in the BSED (Mathematics) Curriculum and Semester/Year Offered:

Math Subject/Descriptive Title	Units	Semester/ Curriculum Year Offered

7. Data on Graduates (for the last 5 years)

Total Number of Graduates	2007	2008	2009	2010	2011
a. BSED (All Majors)					
b. BSED (Mathematics Majors only)					

8. Data on LET Performance (for the last 5 years)

a. LET Secondary (All Majors)	2007	2008	2009	2010	2011
Total Number of BSED Examinees					
Total Number of BSED Passers					
BSED Passing Rate in Percent (%)					

b. LET Secondary (Mathematics Majors Only)	2007	2008	2009	2010	2011
Total Number of BSED (Math) Examinees					
Total Number of BSED (Math) Passers					
BSED (Math) Passing Rate in Percent (%)					

Prepared by:________________________

Position/Designation: ________________________

NOTE:

Data and scanned /photo copy of supporting documents may be sent through any of the following options:

a) fax to:

Ms. Presy A. Antonio
Board Secretary, RMTU, Iba, Zambales
Telefax: (047) 811-1683

b) email at:

fvtamoria@gmail.com

c) mail to:

Ferdinand V. Tamoria
80 Quezon St., San Roque
Castillejos, Zambales 2208

THANK YOU VERY MUCH FOR YOUR MUCH NEEDED HELP AND COOPERATION!

APPENDIX D

SURVEY QUESTIONNAIRE FOR ADMINISTRATORS
(Dean/Chair/Coordinator of Teacher Education)

PERSONAL INFORMATION

1. Name (Optional): ____________________
2. Sex: ___Male ___Female
3. Age: ___20-29 ___30-39 ___40-49 ___50-59 ___60 & above
4. Civil Status: ___Single ___Married ___ (Please Specify)__________
5. School/Campus/Address: ____________________
6. Position/Academic Rank: ____________________
7. Designations:____________________
8. Full Time in the College of Education? ___Yes ___No (Please give details)
9. Educational Qualification:

	Degree	Major / Specialization	School & Year Graduated/Units
Baccalaureate:	________	________	________
Graduate:	________	________	________
Postgraduate:	________	________	________

10. Eligibility/Professional License/Examinations Passed: ____________________

____

11. Professional Associations: ____________________
12. Number of Trainings/Seminars Attended within the Last Five Years Related to:
    Administration & Supervision: _____ Curriculum & Instruction: ______
    Use of Technology: ______ Others: ____
13. Number of Trainings/Seminars Conducted within the Last Five Years Related to:
    Administration & Supervision: _____ Curriculum & Instruction: _____ Others:_____
14. Years of Experience in Teaching:____ As Administrator:_____ As Dean:______

Contact Information: Phone No. ________________ Email: ________________

Kindly answer the following questions relative to the offering of the BSEd (Mathematics) curriculum in your institution/campus. Please attach additional sheets as necessary.

1. Please outline briefly the history of your institution, its teacher education programs and the BSEd (Mathematics) curriculum using the table below.

1.1 Establishment	Name of Institution	Year	Legal Basis
- school			
- state college			
- state university			

1.2 Initial Offering	Programs/Courses Offered	Unit/ Department	Year	Legal Basis
- teacher education courses				
- secondary teacher education program				
- math specialization				

2. Please provide details on the current level/accreditation of your institution and its BSED program as follows.

2.1 SUC Level	Description	Period of Effectivity

2.2 BSED Accreditation Level	Description	Period of Effectivity

3. What were the major reasons/considerations why the BSEd (Mathematics) curriculum has been offered in your institution/campus?

__ great demand for high school mathematics teachers here and abroad
__ availability of qualified mathematics faculty in the institution
__ priority choice of specialization among BSED students
__ petition from parents and other people in the community
__ less costly to offer compared to other areas of specialization
__ others (please specify)____________________________

4. Please make a summary of the series of actions/activities from the review up to the board approval and implementation of the revised BSED (Mathematics) curriculum adapted by your school as per CMO 30 s. 2004, and CMO 52 s. 2007.

Actions/Activities	Persons Involved	Involvement	Inclusive Dates

5. Please check the corresponding level of compliance (in %) of your institution with the minimum requirements set by CHED in CMO 52 s. 2007 for each of the corresponding components.

Area	Below 20 %	40-59 %	20-39 %	60-79 %	80-100 %
Program Administration					
Faculty Development					
Library					
Facilities					
Laboratory/Cooperating Schools					
Student Admission and Retention					

6. Please check the corresponding row and column as to the start/effectivity of implementation of each year in the Revised BSEd (Mathematics) curriculum.

School Year	First Year	Second Year	Third Year	Fourth Year
2005–2006				
2006–2007				
2007–2008				
2008–2009				
2009–2010				
2010–2011				
2011-2012				

7. Kindly check the corresponding level of compliance (in %) of the BSED (Mathematics) curriculum adapted by your institution with the suggested model curriculum by CHED.

Area	Below 20 %	40-59 %	20-39 %	60-79 %	80-100 %
General Education					
Professional Education					
Math Specialization					

8. Please indicate the corresponding number and units of additional subjects and substitute subjects in the BSED (Mathematics) curriculum adapted by your institution.

Area	Additional Subjects		Substitute Subjects	
	Number	Units	Number	Units
General Education				
Professional Education				
Math Specialization				

9. How do you monitor the implementation of the revised BSEd (Mathematics) curriculum in your school?

10. What problems have been encountered by your institution in the implementation of the revised BSEd (Mathematics) curriculum?

11. What innovations / interventions have been designed and used by your institution for effective implementation of the BSEd (Mathematics) curriculum?

12. What other suggestions/recommendations can you give relative to possible revisions on the policies and standards for BSEd (Mathematics) curriculum in the near future?

Thank you very much for your much needed assistance and cooperation!

APPENDIX E

SURVEY QUESTIONNAIRE FOR MATHEMATICS TEACHER EDUCATORS
(for faculty handling mathematics subjects in the BSED-Mathematics Curriculum)

PERSONAL INFORMATION

1. Name (Optional): ____________________________
2. Sex: ___Male ___Female
3. Age in Years : ___20-29 ___30-39 ___40-49 ___50-59 ___60 & above
4. Civil Status: ___Single ___Married ___(Please Specify)____________
5. School/Campus/Address: ____________________________
6. Position/Academic Rank: ____________ College/Department:____________
7. Full Time Teaching in the College of Education? ___Yes ___No
8. Status of Appointment: ___Permanent ___Temporary ___Contractual
9. Educational Qualification:

	Degree	Major / Specialization	Year Graduated/Units Taken
Baccalaureate:	________	________	________
Graduate:	________	________	________
Postgraduate:	________	________	________

10. Eligibility/Professional License/Examinations Passed and Year Taken: ________
____
11. Professional Associations: ____________________________
____
12. Number of Trainings/Seminars Attended within the Last Five Years Related to:
Mathematics: _____ Teaching Strategies: _____ Use of Technology: _____
13. Number of Trainings/Seminars Conducted within the Last Five Years Related to:
Mathematics: _____ Teaching Strategies: _____ Use of Technology: _____
14. Number of Years in Teaching: _____ Years in Teaching Math in BSED: _____

Contact Information: Phone No. ______________ Email: ______________

I. VIEWS ON MATHEMATICS TEACHING (Adapted from Bernardo, 2002)

The paired items below describe learning competencies in mathematics. Kindly express your views on how each pair of competencies should be given emphasis in teaching mathematics. Write the letter that corresponds to your response as follows.

- *A. Only the 1st but not the 2nd must be emphasized.*
- *B. More of the 1st and less of the 2nd should be emphasized.*
- *C. Both the 1st and the 2nd should be equally emphasized.*
- *D. More of the 2nd and less of the 1st should be emphasized.*
- *E. Only the 2nd but not the 1st must be emphasized.*

1.	memorize properties and relations of mathematical objects	____	explore meaning and applications of mathematical concepts
2.	verify conjectures, propositions and arguments	____	state precise definitions, axioms and theorems
3.	perform manual operations with speed and accuracy	____	use appropriate mathematical tools and devices
4.	generate own solutions to practical problems	____	master mathematical skills through drill exercises
5.	work individually on mathematical tasks	____	work together on group activities and projects

II. MATHEMATICS TEACHING PRACTICES (Adapted from Bernardo, 2002)

Items below describe pairs of teaching practices in mathematics. Determine how your own teaching practices are characterized by each of the paired items. Write the letter that corresponds to your response based on the following choices.

- *A. Only the 1st but not the 2nd characterizes my teaching practices.*
- *B. More of the 1st and less of the 2nd characterizes my teaching practices.*
- *C. Both the 1st and the 2nd equally characterize my teaching practices.*
- *D. More of the 2nd and less of the 1st characterizes my teaching practices.*
- *E. Only the 2nd but not the 1st characterizes my teaching practices.*

1.	present mathematics lessons in structured and detailed manner	____	facilitate discussions and negotiations with and among students
2.	quickly address mistakes and difficulties of students	____	consider students' explanations and preferences
3.	provide many exercises for mastery of skills	____	let students formulate and solve their own problems
4.	ensure that students follow instructions and procedures	____	encourage students to explore and learn by discovery
5.	demonstrate quick solutions to mathematics problems	____	provide a wide variety of problems and tasks

III. MATHEMATICS TEACHING SELF-EFFICACY (Based on Bandura, 1994)

The following items describe competencies in teaching mathematics. Read each item carefully and determine how confidently you can do each task. Then, encircle the number that corresponds to your response on each item using the following scale:

1 – I am not confident that I can do this.
2 – I am somewhat confident that I can do this.
3 – I am confident that I can do this.
4 – I am much confident that I can do this effectively.
5 – I am very much confident that I can do this very effectively.

1. Deliver lectures on highly advanced topics in mathematics.	1	2	3	4	5
2. Help students master complicated mathematical operations.	1	2	3	4	5
3. Quickly demonstrate long solutions to mathematical problems.	1	2	3	4	5
4. Answer very difficult questions about lessons in mathematics.	1	2	3	4	5
5. Conduct periodic tests to monitor students' mastery of competencies.	1	2	3	4	5
6. Share historical background or updates about lessons in mathematics.	1	2	3	4	5
7. Develop students' conjecturing, proving and reasoning skills.	1	2	3	4	5
8. Manage class discussions involving small or large groups of students.	1	2	3	4	5
9. Pose mathematical problems involving practical real-life situations.	1	2	3	4	5
10. Provide variety of activities that cater to students' multiple intelligences.	1	2	3	4	5

IV. SELF-RATED TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE

(Adapted from Niess et al., 2009; Schmidt et al., 2009; Landry, 2010)

Items below describe technological, pedagogical and content knowledge (TPACK) in teaching mathematics with the use of graphing calculators, computer algebra systems and other information and communication technologies (ICT). Read each item carefully and determine the extent of your knowledge on each item. Then, encircle the number that corresponds to your response using the following scale:

1 – not at all true of me
2 – slightly true of me
3 – moderately true of me
4 – true of me
5 – very true of me

1. I choose technologies that enhance my teaching approaches.	1	2	3	4	5
2. I choose technologies that enhance my students' learning.	1	2	3	4	5
3. I think critically about how to use technology in my classroom.	1	2	3	4	5
4. I adapt the use of technologies to different teaching activities.	1	2	3	4	5
5. I use technology for understanding and doing mathematics.	1	2	3	4	5
6. I am able to teach lessons that appropriately combine mathematics, technologies and teaching approaches.	1	2	3	4	5
7. I am able to select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.	1	2	3	4	5
8. I use strategies that combine content, technologies and teaching approaches in my classroom.	1	2	3	4	5
9. I am able to help others about effective integration of technology in teaching mathematics.	1	2	3	4	5
10. I easily cope with changing technologies in teaching math.	1	2	3	4	5

2. Please indicate the number of BSED mathematics subjects that you have been teaching in which you have used the following teaching-learning activities:

2.1 problem solving (engaging students to learn by solving real problems) _____
2.2 practical work (performing hands-on activities for conceptual understanding) _____
2.3 cooperative learning (letting students work by teams on group tasks) _____
2.4 math investigation (allowing students to explore problem situations) _____
2.5 other inquiry-based activities (please specify) ________________ _____

3. Kindly check (√) the corresponding period of time when you typically start using each of the following activities in your BSED mathematics classes in any given term.

	Start of Classes	Before Prelim	Before Mid-term	Before Finals	Not at All
3.1 problem solving	_____	_____	_____	_____	_____
3.2 practical work	_____	_____	_____	_____	_____
3.3 cooperative learning	_____	_____	_____	_____	_____
3.4 math investigation	_____	_____	_____	_____	_____
3.5 other inquiry-based activities (please specify)	_____	_____	_____	_____	_____

4. Please check (√) the corresponding row and column as to how frequently you have used each indicated activity in your BSED mathematics classes.

	Never	Seldom	Sometimes	Often	Always
4.1 problem solving	_____	_____	_____	_____	_____
4.2 practical work	_____	_____	_____	_____	_____
4.3 cooperative learning	_____	_____	_____	_____	_____
4.4 math investigation	_____	_____	_____	_____	_____
4.5 other inquiry-based activities (please specify)	_____	_____	_____	_____	_____

5. Kindly indicate the number of BSED mathematics subjects that you have been teaching in which you have integrated the following technologies in actual classroom teaching.

5.1 graphing calculators ________________
5.2 computer algebra systems (CAS) ________________
5.3 electronic spreadsheets (Excel, etc.) ________________
5.4 internet & web technologies ________________
5.5 other technologies (please specify) ________________

6. Please check (√) the corresponding period in any given semester/term when you typically start integrating each indicated technologies in teaching BSED mathematics classes.

	Start of Classes	Before Prelim	Before Mid-term	Before Finals	Not at All
6.1 graphing calculators	_____	_____	_____	_____	_____
6.2 computer algebra systems	_____	_____	_____	_____	_____
6.3 electronic spreadsheets	_____	_____	_____	_____	_____
6.4 internet & web technologies	_____	_____	_____	_____	_____
6.5 other technologies (specify)	_____	_____	_____	_____	_____

7. Kindly check (√) the corresponding row and column as to how often you have integrated each indicated technology in teaching BSED mathematics classes.

	Never	Seldom	Sometimes	Often	Always
7.1 graphing calculators	____	____	____	____	____
7.2 computer algebra systems	____	____	____	____	____
7.3 electronic spreadsheets	____	____	____	____	____
7.4 internet & web technologies	____	____	____	____	____
7.5 other technologies	____	____	____	____	____

8. Kindly check (√) your corresponding purposes for integrating technology in teaching BSED mathematics classes.

__ numerical computation
__ symbolic manipulation
__ tabular presentation
__ pictorial/graphical presentation
__ interactive learning
__ others (please specify) ________________

9. Please check (√) which of the following best characterizes your participation and of students in the use of technology in your BSED mathematics classes.

__ Together, my students and I make use of technology during our math classes.
__ I allow the students to use technology during our math classes.
__ I demonstrate use of technology in class but let students practice outside our class.
__ I encourage my students to use technology but not during our class.
__ My students and I do not use technology in my math classes.

10. Please complete the following statements about your teaching practices in your BSED mathematics classes.

10.1 My philosophy in teaching math is "________________________________
____
____"
____

10.2 If there is a new material, strategy or technology in teaching math, I usually
____
____
____

10.3 Despite limited resources, I am able to manage my math classes effectively by
____
____
____

10.4 To assess learning of students in my math classes, I make use of ____________
____
____
____

N.B.

i. Are you willing to be a respondent in a follow-up interview?

___No.

___Yes. My schedule and/or preferred mode of interview are as follows:

*Day*___________ *Time:* ___________ *Venue:*____________________

Mode: ___*Face-to-Face* ___*Phone* ___*Email* ___*Chat* ___*(Please Specify)*

ii. Are you willing to have your BSED mathematics classes observed?

___No.

___Yes. The schedule of my math classes for observation are:

Subject	*Room Assignment*	*Schedule*
____________	____________	____________
____________	____________	____________
____________	____________	____________

iii. Are you willing to share a video recording of a one-hour session of your actual classroom teaching in one of your BSED mathematics classes?

___No.

___Yes. I will share a video recording of my actual classroom teaching via:

___CD/DVD ___YouTube ___Email ___(Please specify)

Thank you very much for your much needed assistance and cooperation!

APPENDIX F

INTERVIEW GUIDE FOR MATHEMATICS TEACHER EDUCATORS

(for faculty handling mathematics subjects in the BSED-Mathematics Curriculum)

Please answer the following questions as frankly and honestly as you can.

1. What do you know about the revised policies and standards for the BSEd (Mathematics) curriculum and other undergraduate teacher education programs? ____________________

2. How did you know about these revised policies and standards? ____________________

3. In what ways have you participated in the implementation of the above-mentioned policies in your institution? ____________________

4. What were some preparations made by your institution to help you prepare for the implementation of the revised BSED-Math curriculum? ____________________

5. What professional development activities have you attended/engaged in to prepare yourself for teaching mathematics subjects in the revised BSED-Math curriculum?

6. How have these preparations and activities helped you in teaching mathematics subjects in the BSED-Math curriculum? ____

7. How do you consider yourself as a mathematics teacher – traditional or innovative? ____

8. What problems have you encountered in teaching mathematics subjects in the revised BSED (Mathematics) curriculum? ____

9. So far what have you done to effectively carry out the revised BSED (Mathematics) curriculum in your mathematics classes? ____

10. What suggestions and recommendations can you give for the successful implementation of the revised BSED-Math curriculum for future high school math teachers? ____

Thank you very much for your much needed assistance and cooperation!

APPENDIX G

SURVEY QUESTIONNAIRE FOR BSED (MATHEMATICS) STUDENTS

PERSONAL INFORMATION

1. Name (Optional): ______________________________
2. Sex: ___Male ___Female
3. Age in Years: ________
4. School/Campus/Address: ______________________________
5. Course & Year Level: ______________________________
6. High School Graduated From: ____Public ____Private
7. Mathematics Subjects you have taken so far in the BSED Program:

__ Fundamentals of Math
__ Contemporary Math
__ College Algebra
__ Advanced Algebra
__ Trigonometry
__ Plane Geometry
__ Solid Geometry
__ Analytic Geometry
__ Calculus I
__ Calculus II
__ Number Theory
__ Set Theory and Logic
__ Abstract Algebra
__ Linear Algebra
__ Modern Geometry
__ Probability
__ Elementary Statistics
__ Advanced Statistics
__ History of Math
__ Technology in Math
__ Instrumentation in Math
__ Problem Solving in Math
__ Math Investigation and Modeling
__ Action Research in Math Education
__ Others (*please specify*)

Contact Information: Phone No. ________________ Email: ________________

Please answer the following questions as frankly as possible.

1. How would you describe the BSEd (Mathematics) curriculum being offered by your school? ____
____
____
____

2. How would you describe your mathematics instructors/professors in the BSED program – more traditional or more innovative as compared to your high school mathematics teachers?
____
____
____
____

3. Please check (√) the corresponding row and column as to how frequently mathematics instructors/professors have used each indicated activity in your BSED mathematics classes.

	Never	Seldom	Sometimes	Often	Always
3.1 problem solving	____	____	____	____	____
3.2 practical work	____	____	____	____	____
3.3 cooperative learning	____	____	____	____	____
3.4 math investigation	____	____	____	____	____
3.5 other inquiry-based activities (please specify)	____	____	____	____	____

4. On a scale of 1 to 5 (with 5 as the highest), please encircle how effectively have mathematics instructors/professors in your school used the following teaching strategies in your mathematics classes?

4.1 problem solving	1	2	3	4	5
4.2 practical work	1	2	3	4	5
4.3 cooperative learning	1	2	3	4	5
4.4 investigation & modeling	1	2	3	4	5
4.5 other inquiry-based strategies (please specify)	1	2	3	4	5

5. Please check (√) which of the following technologies have been used in actual teaching by instructors/professors in your BSED mathematics classes teachers?

__ scientific calculators
__ graphing calculators
__ computer algebra systems
__ electronic spreadsheets (Excel, etc.)
__ slide presentations (Powerpoint, etc.)
__ internet & web technologies
__ other technologies (please specify)

6. Please check the corresponding row and column as to how frequently have mathematics instructors/professors in your school integrated the following technologies in your mathematics classes.

	Never	Seldom	Sometimes	Often	Always
6.1 graphing calculators	______	______	______	______	______
6.2 computer algebra systems	______	______	______	______	______
6.3 spreadsheets (Excel, etc.)	______	______	______	______	______
6.4 Powerpoint presentations	______	______	______	______	______
6.5 Internet & web technologies	______	______	______	______	______
6.6 other technologies (please specify)	______	______	______	______	______

7. What are your most favorite mathematics subjects in the BSED Mathematics curriculum? Why? ____

8. Please describe how much you have learned from mathematics instructors/professors who integrated technology in your mathematics classes. ____

9. What problems have you met in your mathematics subjects in the BSED-Math curriculum offered by your school? ____

10. What suggestions and recommendations can you give for the effective teaching-learning of mathematics subjects in the revised BSED-Math curriculum? ______________________

____

____

____

____

Thank you very much for your much needed assistance and cooperation!

APPENDIX H

CLASSROOM OBSERVATION CHECKLIST

Name of Math Instructor/Professor Observed: ____________________
School: ____________________
Class/Subject: ____________________ Date: ____________

Please check the corresponding row and column as to how the math teacher demonstrated inquiry-based teaching strategies and integrated technology in the mathematics classroom using the following criteria:

1 - not observed
2 - slightly observed
3 - moderately observed
4 - much observed
5 - very much observed

A. Indicators for inquiry-based teaching strategies	1	2	3	4	5
1. emphasizes problem-solving using variety of real-life problems					
2. provides practical work and project-based learning experiences					
3. engages students in active participation and cooperative learning					
4. lets students learn through discovery, investigation and modeling					
5. uses alternative/authentic assessment of students' learning					
6. demonstrates other inquiry-based teaching strategies (please specify)					

B. Technologies used/integrated in teaching mathematics	1	2	3	4	5
1. scientific and graphing calculators					
2. computer algebra systems and mathematical software					
3. electronic spreadsheets (Excel, etc.)					
4. slide presentations (Powerpoint, etc.)					
5. Internet and web technologies					
6. other technologies (please specify)					

Overall Impressions/Observations/Remarks

About the Teacher: ____________________

____

About the Students: ____________________

____

About the Lesson/Activities: ____________________

____

Observer: ____________________

APPENDIX I

SAMPLE SUMMARY TABLES FOR ANALYZING THE PROFILE AND EXTENT OF ADAPTATION OF INSTITUTIONS

Table I-1

Historical Background of State Institutions in Central Luzon Offering BSEd-Mathematics Curriculum

Historical Event	Period	Frequency
Establishment of School/Institution	1850-1899	2
	1900-1949	7
	1950-1999	1
Conversion to State College	1950-1959	1
	1960-1969	3
	1970-1979	3
	1990-1999	3
Conversion to State University	1960-1969	1
	1980-1989	1
	1990-1999	3
	2000-2009	2
	Not Yet	3
Initial Offering of Teacher Education Program	1950-1959	1
	1960-1969	4
	1970-1979	4
	1990-1999	1
Initial Offering of Mathematics Specialization	1960-1969	4
	1970-1979	1
	1980-1989	3
	2000-2009	2

Table I-2

Typical Profile of State Institutions in Central Luzon by SUC Category of LET Performance

Indicator	Category of LET Performance		
	High	Middle	Low
Number of Years as Institution	100+	<100	100+
Number of Years Offering Math Specialization	40+	<40	40+
Number of Campuses	1+	1	1+
SUC Level	III-A	III-A	III-A
Budget Allocation (in million PhP)	100+	<100	<100
Number of Accredited Programs	20+	<20	<20
BSEd Program Accreditation Level	III	III	II
BSEd Program Administration Compliance	4.67	5	4.35

Table I-3

Extent of Institutional Adaptation by SUC-TEI Category

Extent of Adaptation	SUC-TEI Category of Performance			All SUCs
	Low	Middle	High	
Adoption Time	3.0	4.3	4.2	4.1
Compliance Level	3.0	3.7	4.3	4.0
Degree of Innovation Made	2.0	4.0	3.0	3.2

Table I-4

Quantitative Results and Qualitative Findings about Extent of Institutional Adaptation by SUC-TEI Categories

Extent of Adaptation	SUC-TEI Category of Performance	Quantitative Results	Qualitative Findings
Adoption Time	High	Prompt adoption	2005-2006 to 2007-2008
	Middle	Prompt adoption	2005-2006 to 2006-2007
	Low	Late adoption	2007-2008
Compliance Level	High	High compliance	Not all required major subjects
	Middle	High compliance	Not all required major subjects
	Low	Moderate compliance	Not all required G.E. and major subjects
Degree of Innovation Made	High	Moderate innovation	2 innovations
	Middle	High innovation	3 innovations
	Low	Low innovation	Only 1 innovation

Table I-5

Actions Taken by State Institutions in Central Luzon in Adapting the Revised BSEd-Math Curriculum

SUC-TEI Category	Actions/Activities	Persons Involved	Inclusive Dates
High-Performing SUC-TEI	Review of subjects	Dean, Math	2004
	Deliberation on subjects	Coordinator,	2004
	Approval of subjects	Math Faculty	2004
	Finalization of curriculum & submission for approval	Curriculum Committee, VPAA	2005
	Approval of curriculum	President, BOR	2005
	Implementation	Dean, Math Faculty	2005
Middle-Performing SUC-TEI	Preliminary meeting	Dean, Dept Chair,	2005
	Review, deliberation & finalization	Curr. Coordinator, Math Teachers	2005
	Submission for approval	Academic Council	2005
	Approval of curriculum	President, BOT	2006
	Implementation	Dean, Math Faculty	2006
Low-Performing SUC-TEI	Review & deliberation	Dean, Math Faculty	2006
	Finalization & submission for approval	Director of Instruction,	2006
	Approval of curriculum	VP Academics	2007
	Implementation	President, BOR	2007
		Dean, Math Faculty	

Table I-6

Monitoring Practices of SUC-TEI Categories in Implementing the BSEd-Math Curriculum

Practices in Monitoring Implementation of BSEd-Math Curriculum	SUC-TEI Category of Performance		
	High	Middle	Low
Preparation and revision of course syllabi	√	√	√
Monitoring and observation of classes	√	√	
Assessment of student learning	√	√	√
Retention policy to maintain quality of majors and graduates	√	√	√
Coordination with CHED and external linkages	√	√	

Table I-7

Interventions Done by State Institutions in Central Luzon in Implementing the BSEd-Math Curriculum

Interventions	SUC-TEI Category of Performance		
	High	Middle	Low
Review of BSEd-Math curriculum	√	√	√
Faculty preparation and participation	√	√	√
Monitoring and observation of classes	√	√	
Strict admission policy for math majors	√	√	
Compliance with CMO provisions	√		

Table I-8

Observations about the Course Description, Objectives, and Content of Mathematics Subjects in BSEd-Math by Category of Institution

	Category of SUC-TEI LET Performance		
	Low	Middle	High
Course Description	adopted new specialization subjects but used old general education math subjects	enhanced general education and specialization subjects	adopted but added math subjects in general education; adopted, simplified or enhanced, and added number and units of math specialization subjects
Objectives	low to high level cognitive psychomotor very few affective	low to high level cognitive psychomotor affective	low to high level comprehensive cognitive psychomotor affective
Content	adopted simplified enriched	adopted enriched	adopted rearranged simplified expanded enriched

APPENDIX J

SAMPLE SUMMARY TABLES FOR ANALYZING THE PROFILE, QUALITIES, AND EXTENT OF ADAPTATION OF MTES

Table J-1

Descriptive Statistics for Mathematics Teacher Educators' Characteristics Across SUC-TEI Categories

Qualities of Mathematics Teacher Educators	SUC-TEI Category of Performance		
	Low	Middle	High
Views on Teaching Mathematics	1.96	3.18	2.96
Mathematics Teaching Practices	2.32	2.97	2.88
Self-efficacy in Teaching Mathematics	3.40	3.99	3.83
Technological, Pedagogical and Content Knowledge in Mathematics	3.12	4.04	3.63

Table J-2

Typical Number of Mathematics Subjects in BSEd-Math by Mathematics Teacher Educators Across SUC-TEI Categories

Mathematics Subjects		Category of SUC-TEI LET Performance			OVER ALL
		Low	Middle	High	
Enrolled & Passed	Mean	8.00	11.17	12.20	11.30
	SD	9.27	6.91	9.05	8.33
Attended Training	Mean	2.40	.92	1.85	1.62
	SD	5.37	1.62	3.98	3.55
Conducted Training	Mean	1.60	.50	.90	.86
	SD	3.58	1.45	1.62	1.89
Taught Already	Mean	9.80	9.92	11.20	10.59
	SD	4.82	5.32	4.73	4.84
Willing to Teach	Mean	1.60	8.00	7.75	7.00
	SD	2.51	7.87	7.35	7.27

Table J-3

Extent of Adaptation by Mathematics Teacher Educators Across SUC-TEI Categories of LET Performance

	SUC-TEI Category of LET Performance		
	Low	Middle	High
A. Inquiry-Based Activity			
Adoption Time	3.70	3.75	3.59
Compliance Level	2.75	2.98	2.78
Degree of Innovation Used	3.70	3.75	3.55
B. Technology Integration			
Adoption Time	2.40	2.77	2.61
Compliance Level	1.85	2.35	1.82
Degree of Innovation Used	2.30	2.83	2.42

Table J-4

Frequency Distribution of Mathematics Teacher Educators as to Type of Activities Used Despite Limited Resources and Category of Institution

Activity	SUC-TEI Category of LET Performance					
	Low		Middle		High	
	f	%	f	%	f	%
Inquiry-Based	2	40	5	42	10	50
Inquiry-Based and Traditional	-	-	3	25	3	15
Traditional	1	20	1	8	1	5
No response	2	40	3	25	6	30
Total	5	100	12	100	20	100

Table J-5

Summary of Student Suggestions by Category of Institution

Suggestion	Category of SUC-TEI LET Performance					
	Low		Middle		High	
	f	%	f	%	f	%
More use of technology integration in teaching	6	75	2	25	8	50
Focus on experiential learning of students	3	38	2	25	6	38
More effective mathematics teacher educators	3	38	1	12	4	25
Additional facilities, references, and resources	3	38	1	12	1	6
Alignment and scheduling of math subjects	1	12	2	25	2	12
None	-	-	3	38	1	6

APPENDIX K

Sample Linear Regression Output

Regression

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	N_ACPROG[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: LCOMP

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.737[a]	.543	.486	.58539	2.430

a. Predictors: (Constant), N_ACPROG

b. Dependent Variable: LCOMP

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.259	1	3.259	9.509	.015[a]
	Residual	2.741	8	.343		
	Total	6.000	9			

a. Predictors: (Constant), N_ACPROG

b. Dependent Variable: LCOMP

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	2.976	.380		7.827	.000	2.099	3.853		
	N_ACPROG	.058	.019	.737	3.084	.015	.015	.102	1.000	1.000

a. Dependent Variable: LCOMP

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.9759	4.8379	4.0000	.60171	10
Residual	-.7323	.6858	.0000	.55191	10
Std. Predicted Value	-1.702	1.393	.000	1.000	10
Std. Residual	-1.251	1.171	.000	.943	10

a. Dependent Variable: LCOMP

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions	
				(Constant)	N_ACPROG
1	1	1.873	1.000	.06	.06
	2	.127	3.848	.94	.94

a. Dependent Variable: LCOMP