Mathematics Education Program in Malaysian Universities: Curriculum Emphasis and Preparedness of Students to Become Teachers

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Abstract
Several Malaysian universities are offering degrees for the training of mathematics teachers. Some of the programs are offered under the Faculty of Science, while several others are offered by the Faculty of Education. The planning of the curriculum for mathematics teacher education is based on two schools of thoughts. First, to be a competent mathematics teacher, one must have an in depth knowledge of mathematics and some basics in pedagogy is considered complementary. On the other hand, educationist led mathematics teacher program tend to emphasize more on the pedagogy and is set on a firm belief that high level mathematics content add value to the programme, however it is not necessary for mathematics education students to cover the same content as those who major in mathematics. A study was conducted to identify the emphasis in the contents of the mathematics education curriculum. Based on the types of mathematics education programs offered, students preparedness to become teachers are revealed based on their confidence to teach, pedagogical content knowledge, views of mathematics, aspects that need be emphasized in teaching and their perceived importance of aspects to be incorporated in teaching.

Introduction
In developing a mathematics teacher education program in the university, curriculum planners must identify the types of knowledge and the levels of knowledge acquisition that are necessary to become effective mathematics teachers; and what contexts are most conducive to learning how to teach. One theoretical model of teacher knowledge suggests seven domains of teachers' professional knowledge: knowledge of subject matter, pedagogical content knowledge, knowledge of other contents, knowledge of the curriculum, knowledge of learners, knowledge of educational aims, and general pedagogical knowledge (Shulman & Grossman, 1988; Wilson et al., 1987). Generally, all curriculum planners are in agreement as to the components that need to be included. However, the question is how much of each component need to be emphasized? Graham et al. (2000) found that in most institutions, content courses are typically taught in the mathematics departments whilst methods are conducted by the faculty of education. The segregation between the two major components of mathematics education programs may foster a perspective that methods are unrelated to content or that content is more important than method. Presently, various curriculum structures are used in universities for the training of mathematics teachers. Can the present structure prepare students to teach at all school levels? In Malaysia, a graduate in mathematics education is certified to teach from Form One (Grade 7) to Form 6 (A-level), in Basic Mathematics as well as Additional Mathematics, and even in matriculation colleges. However, observations during teaching practical training indicated that the pre-service teachers lack confidence

and lack pedagogical content knowledge (PCK). They fumble even in teaching the lower forms. PCK refers to a form of knowledge that bundles mathematical knowledge with knowledge of the learners, learning and pedagogy (Ball & Bass, 2000).
In preparing mathematics teachers for their profession, the question remains, should we give more mathematics or more pedagogy? This has been a debate for years. The Nation at Risk Report (1983) stated that "The teacher preparation curriculum is weighted heavily with courses in education methods at the expense of courses in subject to be taught". The report also highlighted that half of the newly appointed mathematics, science and English teachers are not qualified to teach these subjects. Based on his experience educating mathematics teachers and in agreement with the above report, Wu (1997) stated that pedagogy has been over-emphasized in schools of education whereas content knowledge is all but ignored. He further added that the students that are less mathematically prepared may be more prone to being tense and inflexible in conducting teaching and may be unable to answer questions posed by students in class. The same opinion was expressed by Dobbs, Doctoroff and Fisher (2003), who stated that teachers must know the mathematics content very well to achieve the level of confidence in teaching mathematics. Does the mathematics teacher program prepare students to be competent teachers as soon as they start practicing in schools? Should the program focus on preparing mathematics teachers or mathematicians cum teachers?

Objectives

The study aim to determine:

1. the emphasis of universities' mathematics teacher education program.
2. whether the pre-service teachers' confidence to teach, pedagogical content knowledge views of mathematics, aspects that need be emphasized in teaching and their perceived importance of aspects to be incorporated in teaching are significantly different between mathematics education students who undergo different curriculum structure.

Methodology

Mathematics teachers' preparation programs in five Malaysian and one Singaporean universities were examined. The five Malaysian universities were randomly selected from eight universities that offer mathematics education program in the nation, Universiti Puta Malaysia (UPM), Universiti Sains Malaysia (USM), Universiti Pendidikan Sultan Idris (UPSI), Universiti Kebangsaan Malaysia (UKM) and Universiti Malaya (UM). The National Institute of Education (NIE) of the Nanyang Technological University (NTU), being the only institution that offers teacher training program in Singapore, was also included in the study. Subjects selected were final year students from the Bachelor of Science (Mathematics with Education) or Bachelor of Education (Mathematics) program. In total, 268 final year mathematics education students responded to the questionnaires.
The emphasis of each university's mathematics teacher education program was identified based on an analysis of courses offered in each study programs. The courses were identified from the curriculum handbooks of each faculty involved. The curriculum structure was also determined through the interview sessions with faculties.

The main data collection was through a questionnaire. The questionnaire seek to gain information on five dimensions; students' confidence in teaching (12 items, r = .853), pedagogical content knowledge (27 items, r = .912), level of anxiety (61 items, r = .908), importance of implementing certain aspects in teaching (25 items, r = .863) and views of mathematics (49 items, r = .808).

Although many questionnaires for measurement of constructs such as teacher confidence and pedagogical content knowledge are available, the questionnaire used to measure these two constructs were self-developed to adhere to the inspirations of the Malaysian Integrated Curriculum for Secondary School (KBSM - Kurikulum Bersepadu Sekolah Menengah). KBSM places emphases on the use of several teaching approaches including constructivism, contextual learning, cooperative learning, and mastery learning (Ministry of Education, 1989). In line with the aspirations of KBSM, teacher training also reinforced the use of the various teaching approaches.

Many studies have been conducted focusing on teacher confidence in teaching. Although several teaching confidence scales has been developed such as the OSU Teaching Confidence Scale (Woolfolk, 2000), however, it does not project the skills that are expected of Malaysian teachers based on the aspirations of the National Curriculum and the problems faced by new teachers as reported and observed during the students' teaching practice in schools. The questionnaire used in this study was developed based on aspects identified as contributing to pre-service teachers' confidence with regard to the Malaysian context: (i) implementing certain strategies/emphasis/aspects in teaching; (ii) teaching specific levels of education; and (iii) teaching specific school mathematics topics. The anxiety scale and views of mathematics questionnaires was based on several similar scales but was modified for Malaysian contexts.

Results

Table 1 displays the break down of courses for each university's mathematics education program based on categorization of courses. The major categories analyzed are courses in education (pedagogy), courses in mathematics, courses in minor subject apart from electives and compulsory university courses. In Malaysia, a teacher must be able to teach two subjects in school, therefore each teacher must have a major and a minor specialization. To categorize the two types of emphasis in the curriculum, a difference of less than 10 between percentages in courses in mathematics and courses in education is considered as 'Mathematics Teacher' (MT) program, else 'Mathematicians cum Teacher' (M) program. As shown in Table 1, four of the universities emphasize on education components (MT), whilst the other two have heavier concentration on mathematics courses (M). Of all the universities implementing the 'Mathematics Teacher' (MT) program, the program is handled by the faculty of education for three of the four universities. On the other hand, both the 'Mathematicians cum Teacher' (M) program is handled by the faculty of science/mathematics. This further emphasized that the faculty of education belief strongly that good teachers must have sound pedagogical knowledge whilst the faculty of science/mathematics belief that a good mathematics teacher must have a mastery of the content to be taught.

Table 1: Content Emphasis of Mathematics Education Curriculum

	Courses in education (%)	Courses in major subject (Mathematics) (%)	Courses in minor subject (%)	Elective courses (%)	University courses (%)	Total Credit Hours	Type of program
UPM	27.1 – 29.3 %	42.11%	9.8 – 11.3 %	4.5%)	12.8%	133	M
USM	33.1%	40%	15.4%	0	11.5%	128	MT
UPSI	21.9%	42.2%	18.8%	0	17.2%	128	M
UKM	34.4%	32.8%	16.4%	7%	9.4%	128	MT
UM	39.1%	45.9%	0	0	15%	133	MT
NIE	43.5%	48.1%	0	2.3%	6.1%	131	MT

Generally, the respondents' pedagogical content knowledge, confidence in teaching and views of mathematics are positive and moderate. Their perception on what are important in teaching is high, whilst their level of anxiety is low (Table 2). This is based on the general rule provided by Kubiszyn and Borich (1996) who stated that the cut-off point of the mean rating is 3.0 and that scores higher that 3.0 is regarded as positive whilst the contrary is regarded as negative. In addition, according to Nugent, Sieppert, and Hudson (2001) these scores can be conceived as reflecting a magnitude continuum. Higher scores are indicative of greater magnitude and lower scores indicative of lower magnitude. In this study, scores ranging from 3.00 to 4.00 indicated a moderate level, whilst scores 4.00 to 5.00 indicated high level.

Table 2: Overall Mean Scores in the Five Constructs

Respondents' Perception	Mean	Std. Deviation
Importance of implementing certain aspects in teaching	4.3497	.31013
Pedagogical content knowledge	3.8266	.37729
Confidence in teaching	3.6505	.46217
Level of anxiety	2.4132	.45605
Views of mathematics	3.6546	.20152

Table 3 shows the responses in questionnaire based on universities. The university that emphasizes more on mathematics, UPM, showed consistent high scores for all aspects measured and as to be expected, to complement these high scores, a low level of anxiety was found. UPSI, the other mathematically-inclined program showed almost similar pattern.

Table 3: Responses Based on Universities

University (Categorization)	N	Level of confidence Mean (SD)	View of mathematics Mean (SD)	Anxiety level Mean (SD)	Importance of implementing certain aspects of teaching Mean (SD)	Pedagogical content knowledge Mean (SD)
UPM (M)	64	3.74 (.55)	3.74 (.25)	2.35 (.50)	4.47 (.32)	3.94 (.46)
USM (MT)	37	3.71 (.38)	3.63 (.17)	2.41 (.39)	4.31 (.30)	3.87 (.27)
UPSI (M)	43	3.57 (.44)	3.67 (.14)	2.57 (.50)	4.31 (.35)	3.89 (.39)
UKM (MT)	50	3.68 (.32)	3.63 (.15)	2.54 (.39)	4.30 (.25)	3.79 (.37)
UM (MT)	50	3.66 (.41)	3.65 (.16)	2.35 (.42)	4.31 (.31)	3.70 (.27)
NIE (MT)	24	3.35 (.58)	3.48 (.23)	2.14 (.38)	4.31 (.28)	3.69 (.35)
Total	268	3.65 (.46)	3.65 (.20)	2.41 (.47)	4.35 (.31)	3.83 (.38)

M – Mathematicians cum Teacher program, MT – Mathematics Teacher program

Students perceived confidence in teaching, pedagogical content knowledge, level of mathematical anxiety, importance of implementing certain aspects in teaching and views of mathematics are compared between the two types of teacher education programs. This analysis helps determine which of the two programs is better in developing students to be mathematics teachers. In comparing between universities, significant difference was established in (i) level of confidence to teach ($F(5, 262) = 3.091$, $p < .01$). Sheffe's test showed that level of confidence of UPM's students are significantly different to that of NIE's; (ii) in views of mathematics ($F(5, 262) = 6.97$, $p < .01$). Sheffe's test showed that NIE's students' views of mathematics are significantly different to students of UPM, UPSI and UM, (iii) in level of maths anxiety ($F(5, 262) = 4.24$, $p < .01$). Sheffe's test showed that level of maths anxiety of NIE's students are significantly different to students of UPSI and UKM, and (iv) in scores for pedagogical content knowledge ($F(5, 262) = 3.38$, $p < .01$). Sheffe's test showed that scores in PCK of UPM's students are significantly different to students of UM's. However, no significant difference exists in students' view of the importance of implementing certain aspects of teaching between students from different universities.

In comparing the two types of programs, significant difference was established for perceived importance of implementing certain aspects of teaching, view of mathematics and PCK. Curriculum structure for training mathematicians cum teacher develop students better in their views of mathematics, PCK, confidence and their perceived importance of implementing certain aspects of teaching as compared to the mathematics teachers program.

Conclusion

This study showed that more concentration on mathematics do prepare students better in aspects warranted in future teachers. Ball and Bass (2000) contend that "it is not what mathematics teachers know, but how they know it and what they are able to mobilize mathematically in the course of teaching" as critical. Research has shown that the number of mathematics courses taken by teachers does not correlate significantly with their effectiveness as measured by student learning (National Research Council, 2001). This study does not measure effectiveness, however pre-service teachers' scores in the aspects measured seem to show otherwise. Further studies need to be conducted to measure teachers' effectiveness as measured by students' learning.

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