

CONFIDENCE IN TEACHING MATHEMATICS AMONG MALAYSIAN PRE-SERVICE TEACHERS

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This study focuses on the confidence level of mathematics education students in teaching school mathematics. Respondents were 165 final year students from four Malaysian universities. It was found that the respondents showed a strong foundation in mathematics upon entrance to the university. In spite of their strong background in school mathematics, their mean cumulative grade point average (CGPA) during their final year in the university was rather low. The mean confidence level in teaching mathematics was moderate. The respondents showed a relatively high confidence in the pedagogical aspect of teaching. Respondents reported great confidence in teaching Form One to Form Three, however the confidence level declined as the level taught became higher. The confidence level varied with the topics, which was lowest for the topic on probability. Confidence level in solving problems spontaneously during class was low and teaching mathematics in English was the lowest. The results showed that a significant but low positive correlation exists between (i) level of confidence and CGPA and (ii) level of confidence and confidence in implementing specific aspects of teaching. A significant negative correlation was established between (i) level of confidence and CGPA; and (ii) level of confidence and university level mathematics.

Introduction

Teacher education focuses on the provision of pre-service and in-service teachers with opportunities for the acquisition of teacher knowledge and for them to begin their teaching profession with confidence in mathematical content knowledge, pedagogical knowledge, and knowledge about the learners they are to teach. Teacher educators need to know how teachers learn; the types of knowledge, the levels of knowledge and the context of knowledge acquisition that are necessary to become effective teachers. Brown and Borko (1992) regarded learning to teach as the acquisition of knowledge systems or schemata; cognitive skills such as pedagogical problem solving and decision-making; and a set of observable teaching behaviours that simultaneously interact with experience and factors of change.

One theoretical model of teacher knowledge suggests seven domains of teachers' professional knowledge: knowledge of subject matter, pedagogical content knowledge, knowledge of other content, knowledge of the curriculum, knowledge of learners, knowledge of educational aims, and general pedagogical knowledge (Shulman & Grossman, 1988; Wilson, Shulman, & Richert, 1987). Pedagogical content knowledge (PCK), which is of particular interest of this study, is that domain of teachers' knowledge that combines subject matter knowledge and knowledge of pedagogy (Tobin, Tippins, & Gallard, 1994).

Since its inception in 1989, the Integrated Curriculum for Secondary School (KBSM - Kurikulum Bersepadu Sekolah Menengah) has placed 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 the KBSM, teacher training has also reinforced the use of the various teaching approaches.

However, understanding the teaching approaches in theory is quite different from the real implementation in schools. Student teachers have been reported to face constraints in schools, trying to balance between teaching for examinations and teaching for meaning. In reality, beginning teachers often find difficulties to make adjustments in accommodating new approaches of teaching in schools. One of the many reasons why these new teachers may not be able to implement what they were taught during teacher training could be due to a lack of confidence and a lack of pedagogical content knowledge in teaching mathematics.

Teacher training in Malaysian universities focuses on preparing teachers to acquire the Pedagogical Content Knowledge needed to be a competent teacher in the domains of mathematical content, pedagogical content and knowledge of the learners. Students are required to take up courses in mathematics, which compose the major part of the curriculum. Students also take courses on foundation education such as psychology, sociology and teaching methods to enhance the pedagogical knowledge and the learners' knowledge that is needed to be a competent teacher. However, comments received from teacher educators based on their observations during practical teaching in schools indicate the pre-service teachers' lack of confidence and content knowledge, and a lack of confidence in teaching Additional Mathematics and Form Six Mathematics.

Teacher confidence is a great concern among teacher educators since teacher confidence may affect students' confidence and achievement. Many studies have been conducted focusing on teacher confidence in teaching. Dobbs, Doctøff and Fisher (2003) stated that teachers must know the mathematics content very well to achieve the level of confidence in teaching mathematics. Furthermore, based on a case study on teacher confidence in teaching data handling skills, Price and Raiker (1999) found that

teacher confidence affected students' confidence and hence students' achievement in mathematics. According to them, there is substantial research that indicates that most teachers show a significant lack of confidence in teaching mathematics. The same may apply to teachers in Malaysia, especially pre-service teachers. Hence, this study seeks to identify issues pertaining to pre-service teachers' confidence and their acquired mathematical content knowledge.

McLeod (1992) contended that self confidence describes students' beliefs on his own skills. Students' own estimation on their success in mathematics forms a central factor in self confidence (Grigutsch, 1998). According to Grigutsch (1998), self confidence and achievement influence each other. In a study conducted by Kaasila, Pehkonen, Hannula and Laine (2004), success in school mathematics and gender explained more than one-third in the variance of self confidence.

Among the questions that initiated this study were as follows: Did students teachers' success in mathematics relate to their confidence in teaching? How did student teachers perceive their skills in teaching mathematics?

Objectives of the Study

The objectives of the study were:

1. To identify the pre-service teachers' foundation in mathematics content,
2. To identify the level of confidence in implementing certain strategies/emphases/aspects in teaching; teaching specific mathematics content and specific levels of education,
3. To determine the relationship between student teachers achievement in the SPM (Sijil Pelajaran Malaysia – Malaysian Certificate of Education) and university mathematics with their confidence in teaching specific mathematic content and specific levels of education.

Methodology

The Samples

The research adopted the survey method. Respondents in the study were 165 final year students, majoring in mathematics with education, from four Malaysian Universities, namely, Universiti Putra Malaysia (UPM), Universiti Malaya (UM), Universiti Kebangsaan Malaysia (UKM) and Universiti Sains Malaysia (USM). Subjects selected were final year students from the Bachelor of Science (Mathematics with Education) or Bachelor of Education (Mathematics) program. Table 1 shows the distribution of respondents by universities.

Table 1
Distribution of Respondents by Universities

University	N	%
Universiti Putra Malaysia	28	17
Universiti Sains Malaysia	37	22.4
Universiti Kebangsaan Malaysia	50	30.3
University of Malaya	50	30.3
Total	165	100

Instruments

Data collection was conducted using a self developed questionnaire on confidence in teaching mathematics. Although several teaching confidence scales had 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 OSU Teaching Confidence Scale includes teaching skills such as management of classrooms, evaluation of

students' work, use of cooperative learning approaches, teaching of the basic concepts of fractions, and building learning in science on children's intuitive understandings.

The questionnaire used in this study was developed based on aspects identified as contributing to pre-service teachers' confidence with regards 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 questionnaire which consisted of two parts requires respondents to respond to the scale of 'Not Confident At All' to 'Very Confident'. A score of 1 was assigned to the response 'Not Confident At All' and a score of 5 to 'Very Confident'. In the first part of the questionnaire, respondents were asked to respond to 27 items pertaining to their confidence in implementing certain strategies, emphasis, or aspects in teaching KBSM Mathematics. Examples of items were "Developing questions of different cognitive levels based on Bloom's Taxonomy", "Identifying types of questions that could be answered by each category of students; weak, moderate, and high achievers", "Constructing quality examination questions", and "Getting students to work on non-routine, higher order problems". The second part of the questionnaire which consisted of 12 items focused on the respondents' confidence in teaching specific levels of education and teaching specific school mathematics topics. The respondents were required to state their level of confidence on items such as "Teaching Form 6 mathematics" and "Teaching topics related to probability".

The questionnaire was first administered in a pilot study involving 20 final year mathematics education students in UPM. Cronbach's alpha was used to determine the reliability coefficients. Based on the pilot study data (N=20), the reliability coefficients were found to be high for both parts of the questionnaire ($\alpha_1 = 0.88$ and $\alpha_2 = 0.86$). In the main study (N=165), the Cronbach's alpha

reliability coefficients established for the first part of the questionnaire (α_1) was 0.91 and that of for the second part of the questionnaire (α_2) was 0.85. These Cronbach's alpha reliability coefficient scores assure the trustworthiness of the questionnaire in assessing pre-service teachers' perceptions of their confidence level in teaching mathematics.

Data Analysis

The data obtained through the questionnaire was analyzed using the Statistical Package for Social Science (SPSS) software version 12. Descriptive, ANOVA and simple correlation analysis were used.

Findings

In this section, findings of the study are discussed based on the objectives of the study: (i) Pre-service teachers foundation in mathematics content, (ii) Level of confidence in implementing certain strategies/emphases/aspects in teaching, and in teaching specific mathematics content and specific levels of education, and (iii) Relationship between students teachers' achievement in SPM and university mathematics with their confidence in teaching mathematics.

Pre-service Teachers Foundation in Mathematics Content

The Malaysian grading system for SPM is based on the letter grades of A, B, C, P and F. Grades A, B, C, and P are considered as a pass, and F as a fail. The excellent grade A is categorized as 1A and 2A, of which 1A signifies a better grade. Similarly, 3B is a better grade than 4B, and 5C is a better grade than 6C. A grade 'P' indicates that a student only manages to pass the subject, and grade 7P is a better grade as compared to 8P. Grade 9F indicates that the student failed the subject.

Among the total of 165 respondents, 162 pre-service teachers provided the information on the grades that they obtained in the SPM Mathematics. From the data analysis, it is found that the pre-service teachers have a strong foundation at the pre-university level in term of the grades they obtained in the SPM mathematics. The majority (86%) of the respondents obtained 1A in the SPM Mathematics and the lowest grade reported was 3B. The distribution of the respondents' grades in SPM Mathematics is provided in Table 2 below.

Table 2
Distribution of Grades Obtained in SPM Mathematics

Grade	N	%
1A	139	86
2A	16	10
3B	7	4
Total	162	100

Only 158 respondents provided the information on the grades that they obtained in Additional Mathematics at the SPM level. Table 3 shows the distribution of the respondents' grades in Additional Mathematics. The majority of the students (77%) scored between 1A to 4B; a few (19%) were in the C category; and only 4% managed a pass (scored 7P or 8P) in Additional Mathematics at the SPM level. Nevertheless, this small percentage cannot be ignored, as it can be crucial since mathematics students with education majors are expected to be competent teachers at all levels, including Form 6 or Matriculation.

Table 3
Distribution of Grades Obtained in Additional Mathematics

Grades	N	%
1A or 2A	64	40
3B or 4B	58	37
4C, 5C or 6C	30	19
7P or 8P	6	4
Total	158	100

Respondents were also asked to state the average grade that they obtained in university mathematics courses. However, the results as presented in Table 4 show that the strong foundation that they acquired in school mathematics only enabled the majority of them to earn a B average (54%) and a C average (35%) in university mathematics courses. Only 11% of them maintained excellence in mathematics. In terms of cumulative grade point average (CGPA), the CGPA mean was found to be rather low (Mean = 2.30, SD = 0.75). The data indicate that the mathematical content knowledge of pre-service mathematics teachers is just average.

Table 4
Distribution of Average Grades in University Mathematics Courses

Average Grade	N	%
A Average	18	11
B Average	88	54
C Average	56	35
Total	162	100

Level of Confidence in Teaching Specific Mathematics Content and Specific Levels of Education

The findings as presented in Table 5 showed that the pre-service teachers’ level of confidence in teaching was moderate. The pre-service teachers were confident in implementing specific aspects of teaching as suggested in KBSM Mathematics. However, the findings showed that they were less confident in teaching specific school content and specific level of schooling.

Table 5
Mean and Standard Deviation for Confidence in Implementing Certain Aspects of Teaching (M1) and Confidence in Teaching Specific Content and Level (M2)

University	N	M1	SD1	M2	SD2
Universiti Putra Malaysia	28	3.81	0.49	3.85	0.42
Universiti Sains Malaysia	37	3.83	0.29	3.63	0.37
Universiti Kebangsaan Malaysia	50	3.77	0.39	3.57	0.34
University of Malaya	50	3.67	0.28	3.58	0.42
Total	165	3.77	0.45	3.63	0.40

In terms of confidence in implementing certain strategies/emphases/aspects in teaching, respondents indicated that they had the least confidence in (i) teaching mathematics in English (Mean = 3.16, SD = 0.85), (ii) constructing quality examination questions (Mean = 3.37, SD = 0.78), (iii) getting students to work on non-routine, higher order problems (Mean = 3.41, SD = 0.71), (iv) solve problems spontaneously (immediately) in front of the class (Mean = 3.44, SD = 0.62), (v) creating student’s interest in mathematics by introducing historical elements on mathematicians or discoveries in mathematics (Mean = 3.46, SD = 0.76), (vi) guiding students to recognize patterns of problem solving and generalize it to solve other problems (Mean = 3.58, SD = 0.75), and (vii) constructing

examination questions based on student’s ability (Mean = 3.61, SD = 0.73). However, the respondents indicated a high level of confidence in encouraging students to solve complex problems through group discussions (Mean = 4.07, SD = 0.63).

Respondents’ level of confidence in teaching specific levels of secondary mathematics, as shown in Table 6, ranges from a mean of 3.07 to 4.22. They showed the highest confidence in teaching lower secondary mathematics (Mean = 4.22; SD = 0.60) and the confidence level declines as the level of education gets higher. However, the findings indicated that respondents have lower confidence in teaching Form Six (Mean = 3.07; SD = 0.77) as compared to that of teaching at matriculation/college level (Mean = 3.22; SD = 0.77).

Table 6
Mean and Standard Deviation for Level of Confidence in Teaching Specific Levels of Secondary Mathematics (N=165)

Level of Education	Mean	Standard Deviation
Teaching KBSM Mathematics at the lower level (Form 1-3)	4.22	0.60
Teaching KBSM Mathematics at higher level (Form 4-5)	3.91	0.62
Teaching Additional Mathematics	3.55	0.68
Teachings Form 6 Mathematics	3.07	0.77
Teaching mathematics at the matriculation/college level	3.22	0.77

Respondents’ level of confidence in teaching varies with the type of secondary mathematics content as described in Table 7. The mean ranges from 3.27 to 4.01, indicating moderate level of confidence, but not high. The level of confidence is lowest for the teaching of probability (Mean = 3.27, SD = 0.79) and highest for the teaching of algebra (Mean = 4.01, SD = 0.61).

Table 7
Mean and Standard Deviation for Level of Confidence in Teaching Specific Mathematics Content (N=162)

Mathematics	Content	Mean Standard Deviation
Probability	3.27	0.79
Calculus	3.70	0.67
Geometry	3.72	0.80
Statistics	3.72	0.72
Trigonometry	3.92	0.61
Algebra	4.01	0.61

Analysis of variance or ANOVA was also conducted to determine whether the respondents' level of confidence in teaching specific mathematics content and specific levels of education differ by grades obtained in KBSM Mathematics. Table 8 shows that students who scored 3B in Mathematics have the highest level of confidence in teaching school mathematics. There was no significant difference established on the pre-service teachers' level of confidence in teaching mathematics when the data were grouped, based on their SPM Mathematics grades.

Table 8
Mean and Standard Deviation for Level of Confidence in Teaching Specific Mathematics Content and Levels of Education by the SPM Mathematics Grade

	N	Mean	Std Deviation
1A	139	3.63	0.40
2A	16	3.54	0.27
3B	7	3.68	0.38
Total	162	3.62	0.39

Analysis of variance (ANOVA) was also conducted to determine whether the respondents' level of confidence in teaching specific mathematics content and specific levels of education differ by the grades obtained in the SPM Additional Mathematics. Table 9 shows that students who scored an A in Additional Mathematics do have the highest level of confidence in teaching school mathematics. However, the students who only managed to pass the Additional Mathematics subject showed the second highest mean. The small number of respondents in this category could have influenced the mean score. The ANOVA results as presented in Table 10 showed that statistically significant differences exist between the level of confidence among the pre-service teachers as they were grouped by the grades obtained in Additional Mathematics ($F(3, 154) = 4.78, p < 0.05$). Furthermore, Sheffe's test showed that respondents who obtained an A in Additional Mathematics showed significant difference in their level of confidence as compared to respondents who obtained a C.

Table 9
Mean and Standard Deviation for Level of Confidence by Additional Mathematics Grades

Grades	N	Mean	Std Deviation
1A or 2A	64	3.74	0.35
3B or 4B	58	3.59	0.42
4C, 5C or 6C	30	3.43	0.34
7P or 8P	6	3.65	0.20
Total	158	3.62	0.39

Table 10
 ANOVA: Grades in Additional Mathematics by Level of Confidence

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.001	3	0.67	4.78	.003
Within Groups	21.57	154	0.14		

Analysis was also conducted to determine whether the respondents' level of confidence in teaching specific mathematics content and specific levels of education differ by the average grades obtained at the university level. Table 11 shows that students who scored an A average in university mathematics courses showed the highest level of confidence (Mean = 3.99, SD = 0.39). Furthermore, the ANOVA revealed that there is a significant difference on the level of confidence in teaching mathematics content and at specific levels among the three groups (Table 12). Sheffe's test showed that the level of confidence of respondents who scored an A average is statistically significantly higher than that of a B or a C average achievers ($F = (2, 159) = 9.246, p < 0.05$).

Table 11
 Mean and Standard Deviation for Level of Confidence by University Level Mathematics Grades

Average Grade	N	Mean	Std Deviation
A Average	18	3.99	0.39
B Average	88	3.60	0.37
C Average	56	3.56	0.39
Total	162	3.62	0.40

Table 12
 ANOVA: Grades in University Level Mathematics by Level of Confidence

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2.65	2	1.33	9.25	.000
Within Groups	22.80	159	0.14		

Level of Confidence in Implementing Certain Strategies/ Emphases/ Aspects in Teaching

The level of confidence in implementing certain aspects in teaching did not show a definite trend, as compared to the respondents' level of confidence in teaching specific topics and specific grade levels. The ANOVA results showed that there was no significant difference established on the level of confidence in teaching mathematics by the SPM Mathematics grades (Table 13), by the SPM Additional mathematics grades (Table 14) and by mathematics grades at the university level (Table 15).

Table 13
 Mean and Standard Deviation for Level of Confidence in Implementing Certain Aspects of Teaching by SPM Mathematics Grades

SPM Mathematics Grade	N	Mean	Std Deviation
A1	139	3.75	0.37
A2	16	3.82	0.28
B3	7	3.73	0.43
Total	162	3.76	0.36

Table 14
Mean and Standard Deviation for Level of Confidence in Implementing Certain Aspects of Teaching by SPM Additional Mathematics Grade

Group	N	Mean	Std Deviation
1A or 2A	64	3.80	0.40
3B or 4B	58	3.68	0.37
4C, 5C or 6C	30	3.80	0.25
7P or 8P	6	3.78	0.27
Total	158	3.76	0.36

Table 15
Certain Aspects of Teaching by Mathematics University Level Grade Mean and Standard Deviation for Level of Confidence in Implementing

Average Grade	N	Mean	Std Deviation
A Average	18	3.77	0.57
B Average	88	3.77	0.31
C Average	56	3.74	0.35
Total	162	3.76	0.36

Relationship Between Achievement in Mathematics with Level of Confidence in Teaching Specific Mathematics Content and Specific Levels of Education

In the correlation analysis, scores in items pertaining to teaching of specific topics and teaching specific levels were summed up to give one score that indicates the level of confidence. Using simple correlation analysis, the results as presented in Table 16 indicate that there exists a significant low positive correlation between (i) the level of confidence in teaching mathematics and CGPA ($r = 0.21$, $p < 0.01$) and (ii) the level of confidence in teaching mathematics

and of confidence in implementing specific aspects of teaching ($r = 0.46, p < 0.01$). A statistically significant negative correlation was established between (i) the level of confidence in teaching mathematics and the SPM additional mathematics' scores ($r = -0.25, p < 0.01$) and (ii) the level of confidence in teaching mathematics and the university level mathematics' scores ($r = -0.26, p < 0.01$).

Table 16
Relationship between the Level of Confidence in Teaching Mathematics and Pre-service Teachers' Mathematics Score/Grade at the University Level

	Level of Confidence in Teaching Specific Mathematics Content and Specific Levels of Education	
	r	p
Grades Score		
CGPA	0.21**	.008
SPM Additional Mathematics	-0.25**	.002
SPM Mathematics	-0.02	.845
University Level Mathematics	-0.26**	.001
Confidence in implementing specific aspects of teaching	0.46**	.000

** Correlation is significant at the 0.01 level (2-tailed)

Discussions and Implications

The findings of this study showed that Malaysian pre-service mathematics teachers have strong foundation in school mathematics, especially at the SPM level. However, their average performance in mathematics courses at university level is just about a B or C. At the SPM level, there were pre-service mathematics teachers who only managed to obtain a 'pass' grade in SPM Additional Mathematics. Although the number is small, the implications can be quite great. This issue needs to be addressed by teacher training faculties because a graduate teacher majoring in mathematics can be requested to teach mathematics at any level

of education, including Form 6 and Matriculation colleges. Although it is quite difficult to attract very good students to become mathematics teachers, the faculties involved need to determine strategies for improving students' performance in mathematics. Faculties should also conduct road shows in schools and matriculation centres to attract excellent students in mathematics to become mathematics teachers.

Overall, the level of confidence in implementing certain aspects of teaching mathematics and in teaching of specific topics and at specific levels of education, as perceived by student teachers, is moderate. The respondents showed high confidence in the pedagogical aspects of teaching. However, they admitted to be most confident in teaching mathematics at lower secondary classes and least confident in teaching Form Six, Matriculation and Additional Mathematics.

Respondents also indicated that they were least confident in teaching mathematics in English. This shows that many student teachers did not have good competency in English. Therefore, competency in English should be considered as a criterion in the selection of future candidates to teach mathematics in English.

Results showed that pre-service mathematics teachers were least confident in teaching the topic on probability and most confident in teaching algebra and trigonometry. Similar findings were established by the Third International Mathematics and Science Study (TIMSS) (Mullis et al., 1999) in which teachers across 38 countries were reported being least well prepared to teach simple probability. Although courses on probability are included in all mathematics education curricula, this study suggests that part of the course content can be reviewed to incorporate a 'more school related' approach towards probability to help increase teacher confidence.

Findings of the study also showed that pre-service teachers who obtained an A in the SPM Mathematics and Additional Mathematics admitted that they were very confident in teaching school mathematics. As indicated by Price and Raiker (1999) based on their case study, teachers' confidence affect students' confidence and hence, students' achievement in mathematics. Therefore, this calls for a more careful selection of candidates for the mathematics teacher education program. Based on the findings, it is suggested that the mathematics grades in the SPM, STPM or matriculation might be used as a specific criteria in the selection of candidates.

These findings have implications for the preparation of teachers. Typical on-campus mathematics and teaching methods courses do not allow pre-service teachers to have immediate access to real classroom situations. Therefore, mathematics education should create a balance in providing adequate content to develop students' mathematics content, yet providing enough 'school related' content to enhance their confidence during their first few years of their teaching career.

References

- Brown, C. A., & Borko, H. (1992). Becoming a mathematics teacher. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning*. (pp. 209-239). New York: Macmillan.
- Dobbs, J., Doctoroff, G. L. & Fisher, P. H. (2003). *Teaching children Mathematics*. Reston, VA: National Council of Teachers of Mathematics (NCTM).
- Grigutsch, S. (1998). On pupils' views of mathematics and self-concepts: Development, structures and factors of influence. In E. Pehkonen & G. Torner (eds.), *The state-of-art in mathematics-related belief research*, (pp. 169-197), University of Helsinki. Department of Teacher Education Research Report 195.

- Kaasila, R., Pehkonen, E., Hannula, M. & Laine, A. (2004). *Pre-service elementary teachers' self-confidence in mathematics at the beginning of their studies*. A paper presented in the ICME-10 Conference, Copenhagen, July 2004.
- McLeod, D. B. (1992). Research on affect in mathematics education: A reconceptualization. In D. A. Grows (ed.), *Handbook of research on mathematics teaching and learning*, 575-596. London: Macmillan Publishing Co.
- Ministry of Education (1989). *Curriculum specifications for secondary school mathematics*. Kuala Lumpur: Curriculum Development Centre.
- Mullis, I. V. S., Martin, M. O., Gonzalez, E. J., Gregory, K. D., Garden, R. A., O'Connor, K. M., Chrostowski, S. J., & Smith T. A. (1999). Chestnut Hill, MA: International Study Center, Boston College, Lynch School of Education.
- Price, R. & Raiker, A. (1999). Teacher confidence in teaching and learning data handling. [on-line] Available: <http://www.tta.gov.uk/php/read.php?resourceid=1904>. Accessed on 5th April 2005.
- Shulman, L., & Grossman, P. (1988). *Knowledge growth in teaching: A final report to the Spencer Foundation*. Stanford, CA: Stanford University.
- Tobin, K., Tippins, D., & Gallard, A. (1994). Research on instructional strategies for teaching science. In D. Gable (Ed.), *Handbook of research on science teaching and learning: A project of the National Science Teachers Association*, (pp. 45-93). New York: Macmillan.
- Wilson, S. M., Shulman, L. S., & Richert, A. E. (1987). "150 different ways" of knowing: Representations of knowledge in teaching. In J. Calderhead (Ed.), *Exploring teacher" thinking*, (pp. 104-124). London: Cassell.
- Woolfolk, H. A. (2000, April). *Changes in teacher efficacy during the early years of teaching*. Paper presented at the American Educational Research Association, New Orleans, LA.