

PRE-SERVICE MATHEMATICS TEACHERS' CONCEPTIONS OF
TEACHING CRITICAL THINKING

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**To
Almighty GOD,
My beloved family**

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ABSTRACT

This research aimed to investigate the pre-service mathematics teachers' conceptions of teaching critical thinking (CT) giving attention to the concepts, roles and importance, teaching strategies, problems faced and courses in their teacher education related to CT. This qualitative research involved 35 pre-service mathematics teachers who had undergone 12 weeks of teaching practice. They were purposely selected from the Faculty of Education in a public university located in Johor Bharu. The data were collected using open-ended questions which were analyzed using NVIVO 10.0. The findings showed that all of the pre-service mathematics teachers have not acquired comprehensive conceptions of CT. All of them realized that teachers have responsibility to improve students' CT. Majority of them reflected that CT helps students in learning mathematics but many among them did not realize the distinctive advantages of the CT in learning mathematics. Not all of them thought that all students can improve their CT. Besides that, most of them reflected the general strategies and strategies essentially related CT, but they were lack of knowledge in assessing CT during problem solving. The most common problems faced by them in incorporating the CT during their teaching practice were students' understanding and followed by time consuming. Finally, more than one quarters of them mentioned Environmental Chemistry, followed by pedagogy and teaching methods of science and mathematics taught in teacher education as the subjects they learnt that emphasized CT. The results of the study suggested there is a need for teacher education programs to foster the pre-service mathematics teachers' conceptions of CT.

ABSTRAK

Kajian ini bertujuan mengkaji konsep pemikiran kritikal(PK) dalam pengajaran matematik di kalangan guru pelatih matematik yang berfokus kepada konsep, peranan dan kepentingan, strategi pengajaran, masalah dihadapi dan kursus yang dipelajari dalam pendidikan guru mereka berkaitan dengan PK. Kajian kualitatif ini melibatkan 35 orang guru pelatih matematik yang telah menjalani latihan mengajar selama 12 minggu. Mereka dipilih dari Fakulti Pendidikan di sebuah universiti awam yang terletak di Johor Bharu. Data dikumpul dengan menggunakan soalan separa berstruktur dan dianalisis menggunakan NVivo 10.0. Dapatan kajian menunjukkan bahawa guru pelatih matematik tidak memperoleh konsep PK yang menyeluruh. Kesemua mereka menyedari bahawa guru mempunyai tanggungjawab untuk meningkatkan PK pelajar. Majoriti daripada mereka berpendapat bahawa PK membantu pelajar dalam pembelajaran matematik tetapi ramai di antara mereka tidak menyedari kelebihan tersendiri PK dalam pembelajaran matematik. Tidak kesemuanya mereka yang yakin bahawa semua pelajar dapat meningkatkan PK mereka. Di samping itu, kebanyakan mereka menyatakan strategi umum dan strategi dasarnya berkaitan PK, tetapi mereka kekurangan pengetahuan dalam menilai PK semasa menyelesaikan masalah. Masalah yang paling kerap dihadapi oleh mereka dalam mengaplikasikan PK semasa menjalani latihan mengajar adalah pemahaman pelajar dan diikuti dengan memakan masa. Akhirnya, lebih daripada satu perempat daripada mereka yang menyatakan Kimia Alam Sekitar, diikuti dengan pedagogi dan kaedah pengajaran sains dan matematik diajar dalam pendidikan guru yang menekankan PK. Keputusan kajian ini mencadangkan terdapat keperluan bagi pendidikan guru untuk memupuk konsep PK di kalangan guru pelatih matematik.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	THESIS STATUS DECLARATION	
	SUPERVISOR’S CERTIFICATION	
	TITLE	i
	DECLARATION OF ORIGINALITY	ii
	DEDICATION	iii
	ACKNOWLEDGEMENTS	iv
	ABSTRACT	v
	ABSTRAK	vi
	TABLE OF CONTENTS	vii
	LIST OF TABLES	xi
	LIST OF FIGURES	xii
	LIST OF ABBREVIATIONS	xiii
	LIST OF APPENDICES	xiv
1	INTRODUCTION	1
	1.1 Introduction	1
	1.2 Background of Study	3
	1.3 Problem Statement	5
	1.4 Research Objectives of the Study	7
	1.5 Research Questions of the Study	7
	1.6 Conceptual Framework	8
	1.7 Justification for the Study	9
	1.8 Significance of the Study	10
	1.9 Scope of the Study	11

1.10	Operational Definitions of the Study	11
1.10.1	Critical Thinking	11
1.10.1.1	Analyzing	12
1.10.1.2	Evaluating	12
1.10.2	Pre-service teachers	12
1.10.3	Pre-service teachers' Conceptions	13
1.11	Conclusion	13
2	LITERATURE REVIEW	14
2.1	Introduction	14
2.2	Critical thinking in Mathematics Education	15
2.2.1	Problem Solving in Mathematics	16
2.2.2	Communication in Mathematics	17
2.2.3	Reasoning in Mathematics	19
2.2.4	Mathematical Connections	19
2.2.5	Application of Technology	20
2.2.6	Conclusion	21
2.3	Critical Thinking Skills based on Bloom Taxonomy	21
2.4	Critical Thinking in Teaching Mathematics	23
2.5	Teachers' conceptions of Critical Thinking	24
2.6	Conclusion	27
3	RESEARCH METHODOLOGY	28
3.1	Introduction	28
3.2	Research Design/ Procedure	29
3.3	Population and Sample	31
3.4	Research Instrument	32
3.5	Data Collection	34
3.6	Data Analysis	35
3.6.1	Pre-service teachers' concept of the critical thinking	35
3.6.2	Role and importance of critical thinking in learning mathematics	37
3.6.3	Teaching strategies that could help students	38

	improve their critical thinking	
	3.6.4 Problem faced when incorporating critical thinking in teaching mathematics	39
	3.6.5 Incorporation of critical thinking in teacher education.	40
	3.7 Conclusion	41
4	DATA ANALYSIS	42
	4.1 Introduction	42
	4.2 Analysis in Respondents' Demographic	43
	4.2.1 Gender	43
	4.2.2 Race	44
	4.3 Respondents' concept of critical thinking	44
	4.3.1 Item 1: what does the critical thinking means to you?	45
	4.3.1 Item 2: Which of the following situations best represents critical thinking	48
	4.4 Role and importance of critical thinking in learning mathematics.	50
	4.4.1 Item 3: Do you think that you- as a mathematics teacher (future teacher) - have a duty to improve critical thinking of your students?	51
	4.4.2 Item 4: Do you think that teaching for critical thinking would help students learn mathematics in a better way? How?	51
	4.4.3 Item 5: Do you think all students can improve their critical thinking? Please explain.	54
	4.5 Strategies to teach for critical thinking	56
	4.5.1 Item 6: What strategies and techniques can you use in teaching mathematics to help your students improve their critical thinking?	57
	4.5.2 Item 7: How can you evaluate that a student is thinking critically when she/he is engaged in solving	59

	mathematics problems?	
4.6	Problem faced when incorporating critical thinking in teaching mathematics	60
4.6.1	Item 8: What are the problems faced when you were incorporating critical thinking in teaching mathematics during teaching practicum?	60
4.7	Courses teach/ taught Incorporation of critical thinking in teacher education	63
4.7.1	Item 9: Is there any course/s teach (taught) or emphasized on critical thinking in your degree program? Please list down the course/s and explain it briefly.	63
4.8	Conclusion	65
5	DISCUSSIONS, IMPLICATIONS, AND RECOMMENDATIONS	66
5.1	Introduction	66
5.2	Discussions	67
5.2.1	Pre-service teachers' concept of critical thinking	67
5.2.2	Role and importance of critical thinking in learning mathematics	69
5.2.3	Teaching strategies that could help students improve their critical thinking	71
5.2.4	Problem faced when incorporating critical thinking in teaching mathematics	72
5.2.5	Incorporation of critical thinking in teacher education.	74
5.3	Implications of the study	75
5.4	Recommendations for further research	76
5.5	Conclusions	77
	REFERENCES	79
	APPENDICES	83

LIST OF TABLES

TABLE NO.	TITLE	PAGE
3.1	Elements concerned in the questionnaire for each section.	32
3.2	The open-ended questions corresponding to the research questions.	33
4.1	Number of Respondents According To Gender	43
4.2	Number of Respondents According To Their Race	44
4.3	Respondents' responses towards Item 1	45
4.4	Respondents' judgment of the thinking situations as best representing critical thinking	48
4.5	Respondents' conceptions on their role and importance of critical thinking in learning mathematics	50
4.6	Respondents' explanation of how critical thinking could help student in learning mathematics	52
4.7	Respondents' explanation of how all students could improve their critical thinking	54
4.8	Respondents' conceptions of the strategies that enhance critical thinking among students	57
4.9	Respondents' conceptions of how students could show critical thinking when solving problem	59
4.10	Respondents' problem faced when incorporating critical thinking in teaching mathematics	61
4.11	Respondents' responses of the exposure to critical thinking in their teacher education	63

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
3.1	The Research Design	29
3.2	The Research Procedures	30

LIST OF ABBREVIATIONS

CT	-	Critical Thinking
KBSM	-	Kurikulum Bersepadu Sekolah Menengah
PISA	-	Programme for International Student Assessment
PK	-	Pemikiran Kritikal
UTM	-	Universiti Teknologi Malaysia
TIMSS	-	Third International Mathematics And Science Study

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	Research Approval Letter	83
B	Research Instrument Validation	85
C	Data Analysis Validation	87
D	Research Instrument	89
E	Respondents' responses	96

CHAPTER 1

INTRODUCTION

1.1 Introduction

In order to produce high potential generation, Curriculum of Malaysia Education has undergone continuous review and enhancement. As well known, Vision 2020 aims to have a new society which is both competitive in science and progress. National Philosophy of Education Malaysia states:

Education in Malaysia is an ongoing effort to further develop the potential of individuals in a holistic and integrated manner to produce individuals who are intellectually, spiritually, emotionally and physically balanced and harmonious, based on a firm belief in God. Such effort is designed to nurture Malaysian citizens who are knowledgeable and competent, possess high moral standards, responsible and capable of achieving a high level of personal well-being as well as able to contribute to the betterment of the family, the society and the nation at large.

(Curriculum Development Centre, 2006:vi)

Aligned with the philosophy stated above, developing one's potential in thinking skills is one of the focuses in our education system. As referred to Trilling & Fadel (2009), critical thinking is categorized as learning and innovation skills in

this 21st century. The capability to think critically acts as a stronghold to reject the claim of employers worldwide that fresh workers are ill-prepared with basic knowledge and skills. Many education thinkers perceive that critical thinking skills are very crucial for the country's economic success and the learning of the thinking should be integrated in the education. As stated by Ainon & Abdullah (2002), thinking skills plays an important role in helping one to success in the working field rather than only perform in his examination. Therefore, in order to succeed in their daily learning, work and daily life routines, students need to furnish themselves with the set of skills.

Until today, there is no single definition of critical thinking is generally acknowledged. In the context of this study, critical thinking is defined as analyzing and evaluating based on the Revised Bloom Taxonomy (Anderson, 2001). School is a place in preparing a workforce capable of meeting the demands of the workplace. According to Ministry of Education (2006), Mathematics trains the mind to think logically and systematically in solving problems and making decision. Therefore, critical thinking is essential to improve students' thinking that is very much needed and emphasized in Malaysian Mathematics Curriculum.

1.2 Background of the study

Critical thinking has been highlighted in the curriculum since 25 years ago until today. As cited by Yee, Wihad, Jailani, & Tee (2011), in Malaysia, the skills of critical and creative thinking has been emphasised since the drafting of the Integrated Curriculum Secondary Schools (ICSS) in 1988.(Sulaiman, 2000) The above declaration is confirmed by the statement from the Curriculum Development Center (1989) claimed that the contents of the curriculum promote the development of thinking abilities to enable students to analyse, synthesise, explain, draw conclusions, and produce ideas that are both constructive and useful. In order to promote critical and creative thinking skills in the education system, smart school was introduced in 1997 by Ministry, as stated by Hashim (2003). This movement could show that Ministry is paying attention to the development of students' thinking skills. Therefore, as a curriculum implementer, teachers must aware of the importance and conception of teaching the thinking skills.

Based on the Malaysia Mathematics Curriculum (2006), the emphasis of teaching and learning are Problem Solving in Mathematics, Communication in Mathematics, Reasoning in Mathematics, Mathematical Connections and Application of Technology. Generally, critical thinking is one of the highlighted elements in teaching and learning process. Critical thinking and problem solving go hand-in-hand. In order to learn mathematics through problem solving, the students must also learn how to think critically. (Marcut, 2005) According to him, with critical thinking, students will be able to “organize and consolidate their mathematical thinking through communication; communicate their mathematical thinking coherently and clearly to peers, teachers, and others; analyse and evaluate the mathematical thinking and strategies of others; and use the language of mathematics to express mathematical ideas precisely.” According to Marien, Vislocky, & Chapman (2001), students' thinking skills can be developed with the use of the technology to survive in an ever-changing, information-driven society. Clearly, the mathematics curriculum tends to produce individuals who are able to think from different aspects towards a

situation and analyse the problem raised from it, think sharply with an open mind and able to solve the problem critically as well as able to communicate mathematically.

In order to achieve Vision 2020, Malaysian has to become a critical thinker. According to Ho (2011), developing the students' thinking skills is the aim of the school education system. As cited by Hashim (2003), "the KBSM was to develop and enhance students' intellectual capacity with respect to rational, critical and creative thinking." (Ministry of Education Malaysia, 1990) Therefore, the education has the responsibility to train the students' thinking skills.

In order to shape the students' thinking, teacher plays an important role. According to DEMİRHAN, BEŞOLUK & ÖNDER (2011), teachers play a great role in developing students' critical thinking skills and dispositions. Therefore, it is essential in determining and developing teachers' critical thinking skills and dispositions for the provision of effective education as stated by Yücel & Koçak (2010). As cited by Liaw (2010), "conceptual knowledge of mathematics for an educator is an important and critical aspect before they are able to guide students to master it." (Tengku Zawawi, 1997). Unfortunately, according to Mahyuddin (2004), there are not many mathematics teachers in Malaysia who are able to incorporate the thinking skills in their teaching strategies. He also mentioned teachers should be trained to understand and master the thinking skills itself in order to produce students who can think critically and creatively. Based on the study conducted by Mitrevski & Zajkov (2011), the concept of critical thinking is not familiar among the mathematics and science teachers. Therefore, the teachers' conception of critical thinking should be concerned.

Pre-service teachers are the future educators of our younger generations. The preparation and training during teacher training is essential to face the challenges in their future teaching profession. Generally, in teacher education, the professional knowledge related to teaching are, pedagogical knowledge, and pedagogical content knowledge, compulsory education courses such as Science and Mathematics

Curriculum, Philosophy in Education, Educational Psychology, Learning in Science and Mathematics, Fundamental Educational Pedagogy, Microteaching, Method in Teaching Mathematics, Educational Mathematics Lab, Teaching Training, Educational Technology, Sociology and Professionalism in Education and Educational in Mathematics are being taught to the pre-service teachers. According to Faculty of Education (UTM), these courses designed to equip the pre-service teachers with the knowledge and skills to various the teaching strategies, communicate effectively, and think critically and creatively. Therefore, in order to ensure the success of incorporating critical thinking in their future teaching and learning process, they should be well-equipped with the professional knowledge of the thinking skills.

1.3 Problem statement

Critical and creative thinking has been emphasized in the Malaysian curriculum since 1988. According to Anastasiadou & Dimitriadou (2011), critical thinking could improve students' reasoning about problems in daily life. However, there are many students unable to apply the content knowledge gained in school to real world problem after 11 years of schooling.(Hashim, 2003) From the past studies, there are a number of findings showed that the students were unable to master the creative and critical thinking skills in mathematics (Ho, 2011; Liaw, 2010; Fatima, 2007; Norasliza, 2007). The findings were corresponding to the TIMSS 2011 Assessment (2012) where Malaysian students' average scale score keep declining from year to year and ranked at 26. Besides that Malaysian students were ranked at 52 in PISA 2012. These results reflected students' critical thinking was in critical look. Therefore, the factors regarding to critical thinking of students have to be concerned and studied.

Mathematics teachers play an important role in building up the students' thinking skills through teaching and learning process. According to Ho (2011), developing the students' thinking skills is the aim of the school education system. However, the study showed that, even though all teachers realised the importance of critical and creative thinking in developing students, most of the teachers facing skepticism in applying the component of the thinking skills in their teaching process" (Hayati, 2004). Teachers do not know how to improve their students' thinking skills as stated by Ho (2011). This phenomenon might be due to the teacher's lacking of basic ideas of the thinking skills and thus, students were unable to master the thinking skills. Concerning to it, it is undeniable that teacher training is one of the factors affecting the teachers' ideas and abilities in teaching critical thinking.

Along the teacher education programs, the pre-service teachers are attending varieties of educational courses to equip their professional knowledge including critical thinking especially in Fundamental Educational Pedagogy, Method in Teaching Mathematics, Educational Technology and Educational in Mathematics (Faculty of Education (UTM), 2013). This is due to the pre-service teachers' conceptions of critical thinking and their teaching practice during the teacher training will reflect their future practice in the teaching process. As stated by Anastasiadou & Dimitriadou (2011), definitions of critical thinking given by pre-service teachers enable us to understand the manner in which they see knowledge and drive us to expectations about possible teaching processes that the participants are likely to practise in their professional career. Therefore, the study is needed to investigate their conceptions of critical thinking in teaching mathematics in order to ensure the incorporation of the critical thinking in their future teaching and learning process.

1.4 Research Objectives of the study

There are five main objectives of the research, namely:

- i. To determine the pre-service mathematics teachers' conceptions of critical thinking.
- ii. To investigate the pre-service teachers' conceptions on their role and importance of critical thinking in teaching mathematics.
- iii. To investigate the pre-service teachers' conceptions on the teaching critical thinking strategies in Mathematics.
- iv. To identify the problems faced when incorporating critical thinking in teaching Mathematics during their teaching practice.
- v. To identify the course/s in their teacher education that incorporates critical thinking.

1.5 Research Questions of the study

The study sets to answer these research questions:

- i. What are the pre-service mathematics teachers' conceptions of critical thinking?
- ii. What are the pre-service teachers' conceptions on their role and importance of critical thinking in teaching Mathematics?

- iii. What are the pre-service teachers' conceptions on the teaching critical thinking strategies in Mathematics?
- iv. What are the problems faced when incorporating critical thinking in teaching Mathematics during their teaching practice?
- v. What is the course/s in their teacher education that incorporates critical thinking?

1.6 Conceptual framework

The study tends to investigate the pre-service mathematics teachers' conception of critical thinking in teaching Mathematics. In this study, pre-service mathematics' conceptions of critical thinking reflected their ideas and opinions on the critical thinking focusing on their concept, role and importance, teaching strategies, problem faced and courses taught in their teacher education related to critical thinking. This study was based on the two levels (Analyzing, Evaluating) in the Revised Bloom Taxonomy (2001) referred as the critical thinking elements.

The analysing and evaluating in the Revised Bloom Taxonomy (2001) are chosen due to the relevance of the emphasis on the teaching and learning process as stated in the Mathematics Curriculum of Malaysia. According to Ministry of Education (2006), analysing and evaluating are included in the critical thinking skills. As discussed previously, the mathematics curriculum tends to produce individuals who are able to think from different aspects towards a situation and analyse the problem raised from it, think sharply with an open mind and able to solve the problem critically as well as able to communicate mathematically throughout the teaching and learning process. Furthermore, pre-service teachers are taught based on

the Bloom Taxonomy as well in the Teacher Education. Therefore, Revised Bloom Taxonomy (2001) has been referred in this study.

In this study, the research instrument used was open-ended questions to investigate the pre-service teachers' conception of critical thinking in teaching Mathematics. Section A is concerned about the respondents' demographic. Section B consisted of 9 open-ended questions. There were 7 items were adapted from a study conducted by Innabi & Sheikh (2006) and the last two items were prepared in order to reflect pre-service mathematics teachers' critical thinking learning in teacher education.

1.7 Justification for the study

The incorporation of critical thinking in teaching and learning process has been concerned for so many years. According to Choy and Cheah (2009), even students are able to think critically in nature, guidance is needed from their teachers in refining their critical thinking skills. However, teacher's conception knowledge of critical thinking will influence the manner of students' learning since the ability of the students to think critically may be affected by the approach used in directing and conveying the information. Furthermore, according to TIMSS 2007, teacher's performance would influence the students' achievement. Well, pre-service teachers will educate our future generations. Therefore, it is important to identify the pre-service teachers' conception of critical thinking in teaching mathematics.

1.8 Significance of the study

This research can be used as a guidance and reference for pre-service teachers, Faculty of Education, and researchers in the area of critical thinking. The result of this study can serve as reference for pre-service teachers to be aware of the critical thinking emphasised in the mathematics curriculum. Consequently, results of this study might lead pre-service teachers to improve and reflect on their learning critical thinking and encourage them to incorporate the thinking skills in their teaching process in the future.

At the same time, Faculty's authorities are able to understand the actual conceptions of critical thinking among the pre-service teachers. Hence, they can improve and design the courses offered by enhancing the incorporation of critical thinking in the teaching process. Through this, pre-service teachers can be exposed to the teaching strategies for critical thinking comprehensively and thus, they are able to teach more effectively in the future.

The findings of the research will be useful in revising and re-evaluating the capability of the pre-service teachers in incorporating the critical thinking in their future teaching. They will become teachers after their graduation. If they do not receive proper training in injecting the critical thinking in the teaching process throughout their study in teacher education programs, they will lack of competency to lead thinking skills to their students. Therefore, in order to develop students' thinking skills, teachers' training is important.

1.9 Scope of the study

Purposive sampling was used in this research targeting the pre-service teachers who were in their fourth year of study majoring in Mathematics in Faculty of Education. It was carried out in a higher education institution located in Johor Bahru. There were 35 pre-service teachers involved in the research. The pre-service teachers involved in the research are of different gender, races, socioeconomic backgrounds and education level (STPM, Matriculation and Diploma). Fourth year pre-service teachers were chosen as respondents because they had gone through most of the educational courses as mentioned previously throughout the three years of their study and they also had gone through their teaching practice in the last semester. This will help to investigate their competency in incorporating the critical thinking in their future teaching process after studying the courses offered by the Faculty of Education as they will graduate to become a teacher who will work in a school. On the other hand, second and third years pre-service teachers were excluded because they had only learnt some of the educational courses offered and yet to undergo the teaching practice in schools. However, due to the limitation of time, this research was unable to carry out in other institutions of higher learning where Bachelor of Education (Mathematics) is offered.

1.10 Operational definition of the study

1.10.1 Critical thinking

In the study, the elements of critical thinking are defined as Analysing and Evaluating. (Revised Bloom Taxonomy, 2001)

1.10.1.1 Analysing

In this study, Analysing is defined as “examining information in detail by breaking it down into smaller parts to find implicit meanings and relationships.” (Ministry of Education, 2006)

1.10.1.2 Evaluating

In this study, Evaluating is defined as “making judgments on the quality or value of something based on valid reasons or evidence.” (Ministry of Education, 2006)

1.10.2 Pre-service teachers

In this study, pre-service teachers are undergraduate students in their fourth year of study majoring in Mathematics at Faculty of Education and had undergone their teaching practice.

1.10.3 Pre-service Teachers' conception

As cited by Kanik (2010), teachers' conception is defined as the ideas, notions, beliefs, and understanding that teachers have with regard to a particular aspect of their teaching. (Kagan, 1992) In this study, pre-service teachers' conception is related to their ideas and understanding of teaching critical thinking.

1.11 Conclusion

In this 21st century world, critical thinking is viewed as one of the learning and innovation skills as referred to Trilling & Fadel (2009). According to DEMİRHAN, BEŞOLUK & ÖNDER (2011), a great role is played by teachers in developing the students' critical thinking skills and dispositions. Teachers' conceptual knowledge of critical thinking will influence the manner of students' learning since the ability of the students to think critically may be affected by the approach used in directing and conveying the information. The pre-service teachers' teaching practice during the teacher training will reflect their future practice in their teaching process. Therefore, research on the pre-service teachers' conception of critical thinking in teaching mathematics is needed.

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