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A Model of the Effects of Change in Teachers' Beliefs in Mathematical Problem Solving in Malaysia

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Abstract: ***Many previous studies have reported that the term problem solving has been fully investigated in developed countries as can be seen in the work of earlier famous authors and majority of them agreed that a problem occurs only when someone is confronted with a difficulty for which an immediate answer is not available. In short, problem solving refers to the effort needed in achieving a goal or finding a solution when no automatic solution is available. It has however, been identified that there has been little research on mathematical problem solving in developing and newly industrialized nations especially in Malaysia. This research specifically seeks to look into a model of the effects of change in teachers' beliefs in mathematical problem solving in Malaysia. In this study, a few research questions are asked based on the research objectives and hypothesis formulated to tackle the questions. The methodology adopted in this study is quantitative while the statistical package for social sciences is utilized for analyzing the data. Considering the aforementioned findings from analysis of questionnaires the study concludes that; male and female prospective mathematics teachers differ in the way they view the importance of technology usage in solving mathematical problems, that prospective mathematics teachers' beliefs about mathematical problem solving have strong connection to their study level and prospective teachers have both traditional and contemporary views about mathematical problem solving. Hence, the study together with its findings will serve as a guideline to explain and provide empirical evidence which will help in revealing the effects of student teacher's beliefs on mathematical problem solving hence will enable educational policy makers and other interest parties take appropriate decision.***

Keywords: Teachers Beliefs, Model, Mathematical Problem solving, Students, Universiti Teknologi Malaysia

I.0 INTRODUCTION

Currently the field of mathematics education puts emphasis on the problem solving as the approach to be used in day-to-day mathematical lessons. Beliefs have been defined as "Conceptions, personal ideologies, world views and values that shape practice and orient knowledge" [1]. An individual's belief system is a compound of one's conscious or sub-conscious beliefs, hypotheses or expectations and their combinations. For example, beliefs are considered equal to concepts, meanings, propositions, rules, preferences or mental images [2]. On the other hand, beliefs are seen in a much broader sense as "mental constructs that represent the codifications of people's experiences and understandings" and that shape their perception and cognition in any set of circumstances [3]. Teacher's beliefs about mathematical problem solving and the influences on their beliefs are thought to have major impact on implementation of the current innovative way of learning mathematics [4]. This study assumed that gender and study level to be as important independent variables to start with in understanding the influences of teachers' beliefs. Teachers' beliefs about mathematical education have a strong connection to the mathematical lessons they experience as children. As beliefs have a considerable effect on individuals' actions, teachers' beliefs play a crucial role in changing the ways teaching takes place. Hersh [5] indicated that "one's conception of what mathematics is affects one's conception of how it should be presented and one's manner of presenting it is an indication of what one believes to be the most essential in it" (p.13). Basically, teachers possess beliefs about "their profession, their students, how learning takes place, and the subject areas they teach" (Margaret, 2001 cited in [6]. This study assumed that teachers' belief systems about mathematical problem solving may well be categorized into positive and negative beliefs. As noted by [7] who found that teachers' beliefs affected their students attitudes in a way that students of teachers with negative mathematical beliefs showed "a learned helplessness response by passively receiving information", whereas students of teachers with positive mathematical beliefs "explored and discovered mathematical meanings and interrelationships". The theoretical framework of this study focused on traditional views, formalist views, constructivist views and problem solving approaches to teaching in relation to practices, further the categories of teachers' beliefs about mathematical problem solving can be reconstructed. This study assumed that these beliefs categories as independent variables in measuring teachers' beliefs mean scores. Traditional views are based on theory whereby students learn facts and concepts and they understanding by absorbing content through teachers explanations or by reading it from recommended textbooks [8]. Formalist views are based on constructivist view of learning in which learners use their own experiences to construct understanding that make sense to them rather than having understanding delivered to them in already organized form [9]. The main characteristics including learners construct their own understanding, new learning depends on current understanding, learning is facilitated by social interaction, and meaningful learning occurs within authentic learning tasks [10]. There are three important problem solving techniques including teaching *about*, *for* and *through* problem solving [11]. In teaching *about* and *for* problem solving, teachers focus on problem as object of inquiry. Students are required to learn about the problem solving process as well as appropriate strategies such as planning, looking for patterns, estimating, conjecturing, testing conjectures, generalizing and evaluating [12]. On other hand in teaching *through* problem solving focuses on problem solving as a process of inquiry whereby problems are used as means for learning mathematics. The focus is on problem solving and investigation; students have opportunities to explore situations where they can apply their mathematical concepts and ideas [13]. As stated in previous section, this present study uses "study year" as context of mathematical problem solving; since beliefs seem to be formed and changed in the social environment, persons compare these beliefs with their new experiences and with the beliefs of other individuals. Thus their beliefs are under continuous evaluation and change. When one adopts a new belief, this will automatically form a part of the larger structure of one's personal knowledge, of one's belief system; since beliefs never appear fully independently [14].

2.0 Literature Review

2.1 Nature of Mathematical Problem Solving

It is believed that in order to participate fully in democratic processes and to be unrestricted in career choice and advancement, individuals must be able to understand and apply mathematical ideas (George, 1995) cited in [6]. Problem solving is a skill that has been evident throughout the ages, from earliest to modern times. Problem solving helps students learn mathematics by giving them an opportunity to "solidify and extend what they know" by using problems that come from the world that they understand [15]. As a significant aspect of mathematics education, problem solving has gone through an evolution, culminating in today's standard as presented in Principles and Standards for School Mathematics. Polya [16] emphasizes that "solving a problem means finding a way out of difficulty, a way around an obstacle, attaining an aim which was not immediately attainable. Solving problems is the specific achievement of intelligence, and intelligence is the specific gift of mankind, which means, problem solving can be regarded as the most characteristically human activity. The famous mathematician Polya developed the first model of problem solving process that was widely accepted. The model consist a linear and hierarchic process of simplified lists of stages or the steps used in problem solving. Polya's (1945) cited in [16] four stages include understanding the problem, devising a plan, carrying out the plan, looking back. Dewey's [17] four stages of problem solving strategies includes problem's location and definition, suggestion of possible solution, development by reasoning the bearings of the solution, and further observation and experiment leading to its acceptance or rejection. Mason [18] analyze three phases for the process of tackling a question; Entry, Attack and Review. *Thompson [2], corroborated the argument by emphasizing that, "research related to instructions in problem solving has centered on the effectiveness of instructional methods designed to develop global thinking and reasoning processes, specific skills, and general, task specific heuristics." He emphasized that the disproportionately small amount of attention that researchers have given to the role of teachers is troubling.*

Approaching mathematics through problem solving can create a context which simulates real life and therefore justifies the mathematics rather than treating it as an end in itself. The National Council of Teachers of Mathematics [15] recommended that problem solving be the focus of mathematics teaching because, they say, problem solving encompasses skills and functions which are an important part of everyday life.

2.2 Importance of Problem Solving in Mathematics Education

As it has been announced by National Council of Teachers of Mathematics [15], problem solving is an integral part of all mathematics learning. In everyday life and in the workplace, being able to solve problems can lead to great advantages. It has already been pointed out that mathematics is an essential discipline because of its practical role to the individual and society. Through a problem solving approach, this aspect of mathematics can be developed. Presenting a problem and developing the skills needed to solve that problem is more motivational than teaching the skills without a context. Such motivation gives problem solving special value as a vehicle for learning new concepts and skills or the reinforcement of skills already acquired [15]. Quite a number of researchers such as [19, 6, 20, 21] have investigated problem solving and has been given value as a goal for mental development, skill to be taught, and a method of teaching in mathematics education particularly in the last three decades. Several countries like Brazil, China, Japan, Italy, Portugal, Sweden, the United Kingdom" and the United States [15] and currently in developing countries such as Malaysia, South Africa, Nigeria and Tanzania [6, 20, 21] have promoted problem solving to take place in mathematics classes from nursery to secondary level. The reason for this strong emphasis adduced to problem solving instruction currently is because of the peculiarities and significance of problem solving not only for success in everyday living, but also for the future of our environment and advancement of labor.

Problem solving has occurred since the first human being discovered the importance of shelter and food or to flee from the predators [19]. The advancement of human environment resulted in unforeseen environmental contingencies, new problems discovered and led to the urgency to formulate alternative and new methods of finding answers to peculiar scenarios. Meanwhile, mathematics emanated as an answer to these requests and the improvement of mathematics presented more avenues to realize difficult tasks. Shroeder and Lester [12] identified that Problems creates "an atmosphere for students to make known on their conceptions about the nature of mathematics and develop a relational perceptive of mathematics" as the most imperative task of problem solving in mathematics. They highlighted that understanding mathematics is fundamentally seeing how things connect together in mathematics, thinks that the taking down of notes and the act of memorizing mathematical problem solving steps by students prevents them from how things are connected or fit together . Essentially, a person's knowledge relating to mathematical ideas increases to a higher selection of contexts, as one relates a given problem to a superior number of the mathematical ideas implicit in it, or as one constructs relationships among the various mathematical ideas embedded in a problem".

2.3 Technology and Teacher Beliefs

Many authors have researched on the importance of technology and information communication technology (ICT) with the aim of understanding how it is used in classroom environments [22, 23], which beliefs teachers hold towards teaching and learning with technology and how technology could support learners [24, 25] and know how to integrate technology into the curriculum. For example, [26, 22] in an examination to find out ways in which teachers in USA adopt computers in their classrooms, how it impacted on their teaching, and the kinds of barriers experienced while integrating computers into their teaching. At the end of the study, the teachers reported that they had changed from being the only provider of information and knowledge in the classroom to sharing that role with students and providing more complex materials. Moreover, the students were found to be working with increasing independence as a result of computer usage [6, 21]. Therefore, it is concluded that technologies can help teachers to teach differently as well as providing more complex kinds of tasks for students to engage. Furthermore, it is proposed that in order to achieve these professional developments, teachers need adequate time and support while experimenting with technology, and designing and implementing good technology based activities within their curricula.

2.4 Teachers' Beliefs and Mathematics Education

Beliefs are defined as conceptualized true ideas, world views, values and personal ideologies that could shape practice and orient knowledge [27]. Teachers' beliefs have great influences on their curriculum decision making of what to be taught, how it gets taught, what to be learned and how. To improve understanding of teachers' practices, research has been done about the factors affecting their beliefs. For instance, Grouws (1996) investigated possible factors affecting teachers' beliefs about how teaching should take place and concluded that "school goals, classroom climate, the physical setting including availability of instructional equipment and materials, school policies and curriculum guides, administrators, and teachers' colleagues" (p.82) significantly affected teachers' beliefs [6]. Quinn [28] investigated pre-service elementary and secondary school teachers on the impact of mathematical methods courses on their knowledge in mathematics and their attitudes and beliefs about how to teach mathematics. The participants were 47 pre-service teachers at the University of Nevada, Las Vegas. The philosophy of the mathematics methods courses given in the study was highly consistent with the recommendations of NCTM regarding the use of cooperative learning, problem solving and technology. Following the completion of these methods courses, pre-service teachers' knowledge, assumptions, and feelings about mathematics as well as their beliefs about their role as teachers in the classroom changed significantly. Wilkins and Brand [29] corroborated Quinn's study and finds among 89 pre-service teachers that there is a positive relationship between participating in the mathematics methods course and change in teacher beliefs and attitudes.

2.5 Teachers' Beliefs and Classroom Practices

After understanding the factors influencing teachers' beliefs and practices, it is also critically important to know how a classroom culture develops through the interactions of teachers and students. Grouws (1996) explains that each mathematics classroom forms its own culture according to the unique knowledge, beliefs, and values that participants bring to the classroom [6]. For example, the students bring "views of what one does in mathematics class, judgments about how good they are at mathematics, and feeling about how well they like mathematics", whereas the teacher brings to the class "a view of mathematics, routines for teaching the class, expectations about what should be accomplished in the class, personal experience with learning mathematics, and either a like or dislike for the discipline". He concluded that, when all these kinds of beliefs are combined together, the classroom culture develops and reflects all the shared meanings and beliefs that teacher and students bring to the classroom. Ogan-Bekiroglu and Akkoc, [30] recognized the underlying importance of identifying, discussing, and reflecting upon the belief-practice relationship to be a component of every teacher education program.

2.6 Changes in Teachers' Beliefs

Beliefs develop highly gradually and do not change easily [6]. Especially, central beliefs which are more grounded and held more strongly are "less open to rational criticism or change compared to peripheral beliefs which are more open to examination and possible change" [31]. So modifying or changing these strongly held beliefs will have more far reaching consequences than changing the others. Hollifield [32] suggested that if reformers want to improve the content and methodology used in teaching, they need to give their attention to previously formulated beliefs and dispositions of teachers and students. Hollifield [33] emphasized that "supplying new curricula, incentives, or regulations" are not sufficient to change teaching practices as long as "teachers do not understand or do not agree with the goals and strategies" proposed by these innovations. In addition to understanding and agreeing with the new ideas, in order for teachers to willingly change their beliefs, they need to experience cognitive conflicts associated with their current state of teaching, decide to change, make a commitment to change, construct a vision to change, and reflect on their instructional practices. Due to the fact that teachers play a major role in the lives of today's students and tomorrow's adults [19], and long lasting instructional changes only result from essential modifications in what teacher's believe, know, and practice, it becomes vitally imperative to understand teachers' beliefs and the factors influencing these beliefs and how these beliefs affect their classroom practices. Teachers believes are the main issue in term of changes in their teaching; but as Guskey [33] suggests; changes in teacher's believes and attitudes follow changes in students outcomes which, in turn, follow changes in teacher practice and this is indicated in the Figure 1 which he proposed:

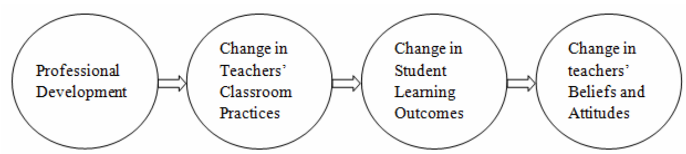

Figure 1: A Model of Teacher Change [33]

2.7 Teacher's Beliefs and Students Learning

Empirical evidence are bound that [21, 29] teachers' beliefs are significantly connected to teachers' classroom practices and, consequently to students' learning in mathematics. Yet, the significant changes discovered in students' performance are half to half as related to the changes in teacher's beliefs and classroom practices, for example "how teachers discharge their responsibility as regards the subject matter, the kinds of task they set, assessment methods, procedures and criteria" [18]. As a result teachers' beliefs, knowledge, judgments, and decisions have a close relation with students' beliefs, attitudes and performance in mathematics, it becomes highly imperative to understand these beliefs and be aware of their impact on classroom practices.

2.8 Gender Differences and Mathematical Beliefs

Research on mathematics and gender has been singled out as one area where "some aspects of beliefs about self-have been researched quite thoroughly". Although gender differences in mathematics achievement have been declining and even disappearing in some cases [34], there are still clear gender differences in beliefs, attitudes and choosing of noncompulsory courses in mathematics [34]. The strongest gender difference in mathematical beliefs has been the fact that boys perceive mathematics as a male domain, whereas girls see mathematics as more or less gender neutral [21]. Another clear gender difference is that boys have higher self-confidence in mathematics than do girls do. Girls are also more prone to mathematics anxiety than boys [35]. This knowledge on gender differences in beliefs has led to some changes in national policies of education.

Mohd et al. [36] find in their study of the level of patience and confidence towards problem solving and mathematics Achievement of Students in a Technical Institute that no significant difference exist between gender and attitude towards problem solving. This is consistent with findings from several previous researches. They opine that this may be as a result of equal attention being given to both categories of students, not minding their gender difference; hence, students' attitude towards problem solving in mathematics was not influenced by gender. Duru [37] on the other hand investigated the gender differences in the mathematics performance of pre-service teachers over a four-year period and found that pre-service primary teachers' mathematics performances were not influenced by gender.

3.0 Methodology for the Research

The researcher carried out this empirical investigation in Malaysia. The decision to make use of this methodology is because it has been acknowledged as the best approach to gather data from several population samples. This survey is made up of three sections which include; the demographic data of the participants, beliefs that are related to the solving of mathematical problems and beliefs related to problem solving evaluation of mathematics. The respondents of this survey were asked to fill out questionnaires survey designed in form of a Likert scale of 5. The SPSS version 16.0 was used to analyze survey responses from 76 students chosen randomly among undergraduate students of the faculty of mathematics education.

3.1 Study Objectives

The broad objective of the study is to investigate a model of the effects of change in teachers' beliefs in mathematical problem solving in Malaysia

3.2 Study Questions

The following research questions have been used in order to achieve the research objectives:

What beliefs about mathematical problem solving do student mathematics teachers have?

What is the connection between gender and study year to student mathematics teachers beliefs?

3.3 Hypotheses

There is no significant difference in the beliefs of student mathematics teachers on applying methods in solving mathematical problems with regards to their level of study.

There is no significant difference in the perception of student mathematics teachers on time consuming in solving mathematical problems with regards to their level of study.

There is no significant difference between male and female student mathematics teachers' beliefs on the application of methods in solving mathematically related problems.

There is no significant difference between male and female student mathematics teachers' beliefs on the time consuming in solving mathematically related problems.

3.4 Participants' Background Characteristics

The study involves 76 mathematics education student teachers from one of the reputable universities in Malaysia. The participants' background information includes, gender, study year, grade point averages (GPA), study courses related to problem solving, interest on problem solving courses, completion on courses related to pedagogy, and completion on compulsory courses related to mathematics. With regard to gender, out of 76 respondents who participated in the interview, 24 (31.6%) were male and female were 52 (68.4%). Referring to study year, out of 76 of respondents, 20 (26.3%) were year one, 21(27.6%) were year two, 21 (27.6%) were year three and 14 (18.4%) were in year four. Based on the study analysis, it was found that study population scored at least 2.7 Grade Point Average (GPA) in their last semester. Fifty respondents (65.8%) scored more than 3.0 Grade Point Average and 16 (21.1%) scored between 2.7 and 3.0 Grade Point Average. The study also found that out of 76 respondents to study questionnaire, 47 (61.8%) were teachers and non-teachers were 24(31.6%).

The study found that about 60% of respondents have taken courses related to problem solving, while the remaining 40% of the respondents did not take any course related to problem solving.

4.0 Discussions from Findings

4.1 Beliefs about the Importance of Understanding Problem Solution

The study examined the participants' responses to the importance of understanding why a mathematical problem solution works. Four positively stated items and two negatively stated items were used. The results reveal that approximately 79% of student teachers (with the mean of 1.84) did not believe (overall responses of strongly disagree and disagree) that it is not important to understand why a mathematical procedure works as long as it gives a correct answer. Forty eight (63.2%) of participants (with the mean of 3.64) believe that an individual really solved a problem if he has good understanding to the obtainable solution. About 42% of participants (with the mean of 2.96) negatively perceived that it does not really matter if you understand a mathematics problem as long as you get the right answer. Likewise, 54 (71.1%) of the participants (with the mean of 3.86) believe that in addition to getting a right answer in mathematics, it is also important to understand why the answer is correct. Approximately 70% of student teachers (with the mean of 3.82 and 3.86 respectively) supported the idea of spending time in giving reasons to why the solution works to a particular mathematical problem. Most of participants (88.2%) valued a good demonstration of reasons to mathematical solution rather than focusing to a right answer. Thus, as it can be observed in figure 2 below, most of participants (66%) have positive believe about the importance of understanding problem solution. This shows that majority of student teachers have positive beliefs about the importance of understanding problem solution.

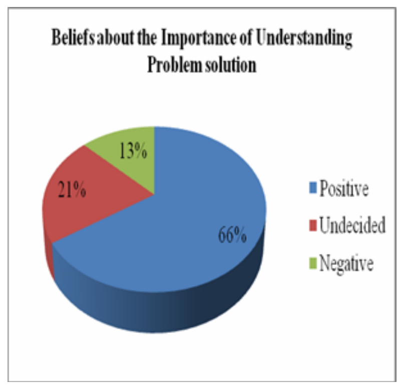

Figure 2 Beliefs on the Importance of understanding solution

4.2 Beliefs about the use of Predetermined Sequence of Steps

The study investigated the participants' responses to questionnaire items related to a thought that there are mathematical problems that can be solved with no encoded procedures. Four positively stated items and four negatively stated items were used. The results show that, the majority (80.3%) of student teachers (with the mean of 4.29) believe that any problem can be solved if you know the right steps to follow. About 50% of respondents (with the mean of 3.26) believe that mathematics problems can only be solved using an encoded procedure. Thirty three (43.5%) of respondents believe that some problems just can be solved without following encoded procedures, whereas 35 (46.1%) of respondents reported indecision. Fifty six (73.7%) of respondents (with the mean of 3.91) believe that mathematicians rarely have step-by-step procedures to solve mathematical problems. Though the item is negatively stated, about 79% of student teachers believe (with the mean of 4.04) that students should be taught the correct procedure to solve mathematics problems. However, only 2 participants show negative belief with this notion and other 14 participants reported indecision. In some cases, participants' responses indicated no strong belief since their responses were almost evenly distributed showing positive perception, negative perception and indecision to these ideas. For example, about 41% of participants have negative belief about the irrelevance of memorizing formula while solving problems, 28% of participants have positive belief, whereas 32% of participants reported indecision. Likewise, about 48% of participants show positive belief on the irrelevance of memorizing steps for learning to solve problems, 26% of participants have negative belief to this notion, whereas 30% of participants reported indecision. Moreover, that negatively articulated that learning to solve problem is the matter of memorizing the right steps, 46% of participants (with the mean of 3.43) show positive belief whereas 34.2% of participants reported indecision. Thus, as shown in figure 3 below, only 31% of participants have positive believe about the application of predetermine sequence of steps in solving mathematical problems. This shows that majority of student teachers have negative beliefs about the use of predetermine sequence of steps in solving mathematical problems.

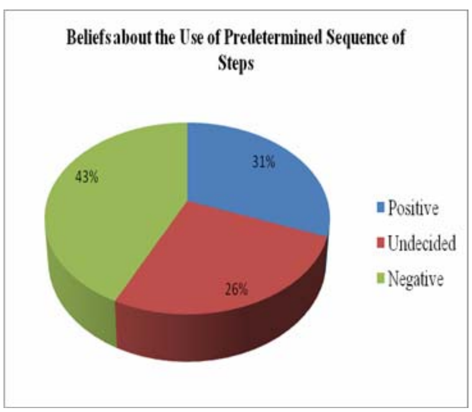

Figure 3 Beliefs on the use of Predetermine Sequence Steps

4.3 Beliefs about the Time Consuming in Solving Mathematics Problems

Time consuming is the crucial notion in mathematical problem solving. The study investigated the participants' responses to the items related to time consuming in solving mathematical problems. There were positively and negatively stated items related to this category. The result shows that, 50% of participants did not believe (with the mean of 2.54) that mathematics problems that take time to complete cannot be solved. However, the participants' responses indicated no strong belief to the idea that time consuming problems are not bothering. Mostly, the participants' responses were evenly distributed, approximately, 33% of participants show positive belief, 28% show negative belief and about 40% reported indecision. Furthermore, approximately, 34% of the participants believe (with the mean of 3.14) that a person can solve a difficult mathematical problem if he puts great effort on that, while more than 46% of participants reported indecision. On other hand, though the statement is negatively stated, 54% of participants appreciated (with the mean of 3.32) to the idea that good mathematics problem solvers are able to solve problems very fast. Hence, as shown in figure 4 below, only 37% of participants have positive believe about the time consuming in solving mathematical problems. This also shows that majority of student teachers have negative beliefs about the available time in solving mathematical problems.

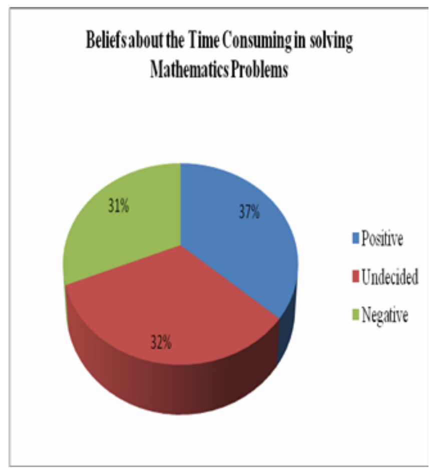

Figure 4 Beliefs about Time Consuming in solving Mathematics Problems

Study Question 2: *What is the connection between gender and study year to prospective mathematics teachers beliefs?*

The aim of this question was to understand the connection of gender and study year to teachers' mathematical problem solving beliefs. Three hypotheses were formed; t test was carried out to ascertain whether or not differences exist between male and female respondents on their beliefs based on the questionnaire items related to application of methods, time consuming and technology usage in solving mathematical problems. Similarly, using ANOVA test and Fisher's LSD post hoc ANOVA test, the responses of respondents were also equally examined based on their level of study with respect to questionnaire items related to application of method, time consuming and application of technology, in order to know whether there is any significant difference in their perception.

4.4 Mathematical Problem Solving Beliefs Based on Level of Study

This study seeks to understand the relationship between level of study and respondents' beliefs on the questionnaire items related to application of methods in solving mathematical problems. One Way ANOVA test and Fisher's LSD post hoc ANOVA test were used to test the participants' responses on these items.

Hypothesis 1: *There is no significant difference in the beliefs of students mathematics teachers on applying methods in solving mathematical problems with regards to their level of study.*

This study seeks to understand the connection between level of study and respondents' beliefs on applying methods in solving mathematical problems. The results are shown in Table 1. The results of respondents' responses on the method of application related to the items are shown in Table 1

Table 1*: One-way ANOVA Test that Determines Mean Difference of Respondents' Beliefs on applying methods in solving mathematical problems according to Level of Study.*

	Sum of Square	*f*	*Mean square*	*F*	***Sig***
Between Groups	*274.213*		*91.404*	*4.780*	*.004*
Within Groups	*1376.774*	*2*	*19.122*		
Total	*1650.987*	*5*			

**Significant at level p< 0.05*

The results show that there is a significant difference [F (3, 72) =4.780, P<0.05] in the beliefs of the respondents on applying methods in solving mathematical problems based on their level of study. In other to know how this difference exists across the various levels of study, a Post Hoc ANOVA test was carried out; the results are shown in Table 2.

Table 2: *Fisher's LSD Post Hoc ANOVA Test for Beliefs of Respondents on applying methods in solving mathematical problems*

Level of Study	*Mean Difference*	*Sig.*
Year 1- Year 2	*-2.51190*	*.070*
Year 1- Year 3	*-5.03571**	*.000*
Year 1- Year 4	*-3.67857**	*.018*
Year 2- Year 1	*2.51190*	*.070*
Year 2- Year 3	*-2.52381*	*.066*
Year 2- Year 4	*-1.16667*	*.442*
Year 3- Year 1	*-5.03571**	*.000*
Year 3- Year 2	*2.52381*	*.066*
Year 3- Year 4	*1.35714*	*.371*
Year 4- Year 1	*3.67857**	*.018*
Year 4- Year 2	*1.16667*	*.442*
Year4- Year 3	*-1.35714*	*.371*

**Significant at level p< 0.05*

Based on Fisher's LSD post hoc test, the results show that those in 1st year differ with those in the third 3rd and 4th year in their beliefs regarding the use of methods in solving mathematical problems (P<0.05) while those in the 2nd year do not differ (P>0.05) with other levels (1st, 3rd, 4th) and those in 3rd year do not equally differ with 2nd and 4th year (P>0.05). From this result, it could be deduced that there is a significant mean score difference in beliefs of 1st year students with other levels regarding the use of methods in solving mathematical problems. This means, there is a connection between student mathematics teachers study level and their beliefs in applying methods in solving mathematical problems.

Hypothesis 2: *There is no significant difference in the perception of student mathematics teachers on time consuming in solving mathematical problems with regards to their level of study. The study seeks to understand the relationship between level of study and respondents' beliefs about time consuming in solving mathematical problems. The results of respondents' responses on the time consuming related items are shown in Table 3.*

Table 3: *One-way ANOVA Test that Determines Mean Difference of Respondents' Beliefs on Time Consuming in solving mathematical problems based on Level of Study*

	Sum of Square	*df*	*Mean square*	*F*	*Sig.*
Between Groups	*12.787*	*3*	*4.262*	*0.569*	*0.637*
Within Groups	*539.002*	*72*	*7.486*		
Total	*551.789*	*75*			

**Significant at level p< 0.05*

The results show that there is no significant difference [F (3,72) =0.569, P>0.05] in the beliefs of respondents based on time consuming in solving mathematical problems regarding to their level of study. What this implies, is that respondents across the four levels of study do not differ in their beliefs about time consuming in solving mathematical problems. The Post Hoc test then was conducted and the result is shown in Table 4.

Table 4: *Fisher's LSD Post Hoc ANOVA Test for Beliefs of Respondents on Time Consuming in solving mathematical problems*

Level of Study	Mean Difference	Sig.
Year 1- Year 2	-0.25476	0.767
Year 1- Year 3	-0.92143	0.285
Year 1- Year 4	0.15000	0.875
Year 2- Year 1	0.25476	0.767
Year 2- Year 3	-0.66667	0.432
Year 2- Year 4	0.40476	0.669
Year 3- Year 1	0.92143	0.285
Year 3- Year 2	0.66667	0.432
Year 3- Year 4	1.07143	0.260
Year 4- Year 1	-0.15000	0.875
Year 4- Year 2	-0.40476	0.669
Year4- Year 3	-1.07143	0.260

**Significant at level p< 0.05*

Likewise, based on Fisher's LSD post hoc test show that there are no significant mean score differences across the four levels of study (P>0.05) regarding respondents' beliefs on time consuming in solving mathematical problems. This means, student mathematics teachers were similar in beliefs across the four study levels regarding the time consuming mathematical problems.

4.5 Mathematical Problem Solving Beliefs Based on Gender

This study seeks to understand the connection between gender and respondents' beliefs on the questionnaire items related to application of methods, time consuming and technology usage in solving mathematical problems. The respondents' responses on these items were equally examined using t-test.

Hypothesis 3: *There is no significant difference between male and female prospective mathematics teachers' beliefs on the time consuming in solving mathematically related problems. The independent sample t-test was conducted to compare the difference in perception between male and female student mathematics teachers regarding to time consuming in solving mathematically related problems. The t–test results of respondents' responses on the time consuming related items are shown in Table 5.*

Table 5: *T –test to Determine Mean Difference Belief score in Time Consuming based on Gender*

Gender	N	Mean	Std	t	Sig.
Male	24	15.5833	3.06334	-0.793	0.430
Female	52	16.1154	2.54877		

**Significant at level p< 0.05*

Results show that there was no significant difference in belief mean scores for male student teachers (M = 15.5833, SD= 3.06334) and female student teachers (M =16.1154, SD= 2.54877) conditions; t (74) = -0.793, P = 0.430. These results suggest that time consuming to the prospective mathematics teachers do not really count when it comes to solving mathematically related problems. This reveals that male and female student teachers were similar in their beliefs based on the time consuming in solving mathematical problems.

4.6 Research Conceptual Model

One of study objectives was to understand whether or not gender and study level are influencing factors on the way student mathematics teachers view the nature of mathematical problem solving. Earlier studies [38, 33, 6, 21] dealing with teacher beliefs as a component on mathematics learning have been more helpful in conceptualizing the present research model. The results of this investigation also provide evidence to support the predicted influencing factors on the present study improved model. The investigation results confirmed the existence and influence of each factor on teachers' beliefs as presented in the improved model (Figure 6). Generally, this new model acknowledges the importance of teachers' beliefs in classroom practices and student learning outcomes, as well as the dominant impact on the nature of mathematical problem solving on teachers knowledge and understanding of the learning and teaching of mathematics. The study conceptual model states, teachers' beliefs are central to development of mathematical problem solving. The framework shows the effect of teachers' beliefs on their classroom practices and students as a learner. In the classroom, teachers' perception about mathematical problem solving would affect the teaching and learning through mathematical problem solving as well as the existing true beliefs on the nature of mathematical problem solving. Teachers' beliefs on mathematical problem solving also affects students learning outcomes, whether in positive or negative ways. Teachers existing beliefs, whether it is positive or negative have connection to the belief components of mathematical problem solving as well as student learning outcomes. The framework emphasizes the centrality of teachers' beliefs on mathematical problem solving abilities as well as education development. Teaching is more than teachers' action; it is an interaction among the teachers' action, the students' action, and the content. Now, it implies that the change in teachers' beliefs will cause change in teaching of the subject matter; change in teaching and learning environment; and change in students' mathematical problem solving outcomes. Teachers' gender, though, may have great contribution to students' learning outcomes, teachers' classroom practices, and teachers' beliefs on mathematical problem solving. Mostly teachers' gender consequences occur when it comes to gender stereotype, the perceptions that mathematics as a male domain subject. This study assumes that teachers' beliefs and study level are reciprocally related to each other. Moreover, a two-way dotted arrow inserted between teacher beliefs and student study level indicates that the relationship impact on each other in both direction. Teachers' beliefs might affect their decision making on subject matter to be taught at particular level, as well as, student study level may influence teachers' decision making on the content to be taught and the way it should be presented. The improved model is presented below in Figure 6.

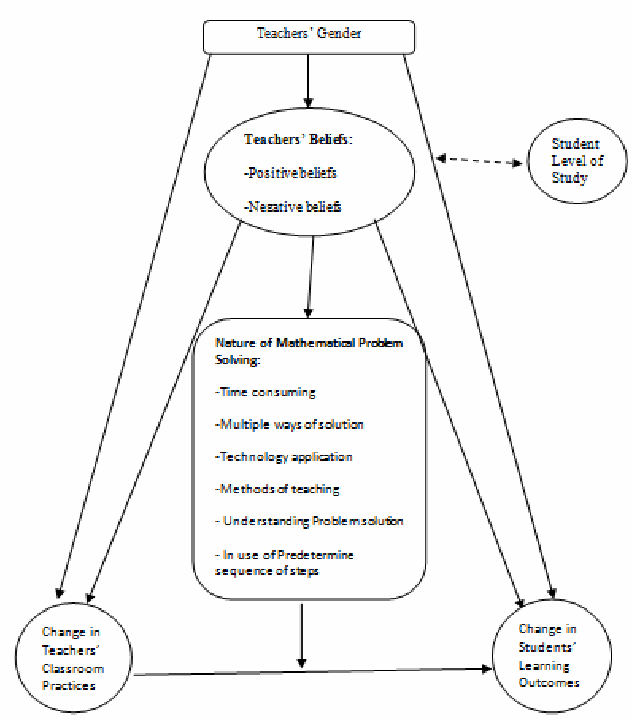

Figure 6: *Improved Conceptual Model for Teachers' Beliefs*

5.0 Conclusions and Recommendations

Considering discussions from findings of this investigation on the effects of student teacher's beliefs on mathematical problem solving in Malaysia. There is need for students in colleges of education and practicing teachers to have a good grasp of mathematical problem solving approach and develop a positive attitude and belief towards the subject. This positive belief has been found to be central to the development of mathematical problem solving in Malaysia.

As a result of this, it is necessary for educational policy makers in Malaysia to ensure that student teachers and teachers alike undergo continuous on the job training to update and upgrade their problem solving skills, because confidence developed as a result of this mandatory training will boost the beliefs of students, however, making them develop a good problem solving skills which is required for economic development of the country. It was also acknowledged in the literature review and findings from this study that the more knowledgeable teachers are in mathematical problem solving, the more confident they become in discharging their job responsibilities and hence building that much needed courage in their students to see mathematical problems as something that is surmountable with the right skills and determination.

In view of the above findings, the ministry of education in Malaysia is advised to mandate educational training institutions in the country to carry out constant mathematical problem solving development to their teachers and potential teachers in order to sharpen their skills from time to time on current approaches to mathematical problem solving. The model presented in this study will also be useful to policy makers in the country in understanding the different factors that determine teacher's classroom practices and students learning outcomes. This vivid understanding will assist educational policy makers take suitable decisions that will enhance the standard of education in Malaysia.

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