

INTEGRATING ICT IN MATHEMATICS TEACHING METHODS COURSE: HOW HAS ICT CHANGED STUDENT TEACHERS' PERCEPTION ABOUT PROBLEM SOLVING

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ABSTRACT Problem solving is characteristic of mathematical activity and an important way of developing mathematical knowledge. A main purpose of mathematics teaching and learning is to develop the ability to solve a wide variety of complex mathematics problems. However, the process of problem solving in mathematics has not been given the proper recognition, probably due to the fact that teachers themselves are not comfortable with problem solving. As a result, teachers do not teach the process and technique of problem solving as an integral part of mathematics learning process. This paper will look into student teachers' beliefs about problem solving and how these beliefs change with the use of Information Technology. This move is actually an effort to integrate Information Communication Technology in a Mathematics Teaching Methods Course with the intention of changing the student teachers' beliefs and perception about problem solving so that they can become better problem solvers themselves and also to encourage students to develop a broad range of problem solving strategies.

INTRODUCTION

The process of problem solving, according to Polya (1957), involves four steps: understanding the problem, devising a plan (solution), implementing the plan and looking back (examining the solution). These processes demand the ability to develop a deep understanding of the problem and to devise a plan to solve it. Problem solving (Polya, 1973; Schoenfeld, 1985) has been advocated as revealing more of the strategies employed by children in the course of solving mathematical problems. While problem solving can be described through the use of heuristics and meta-cognitive strategies, the underlying assumption is that all mathematical entities consist of well-organized structures, waiting to be discovered. Teachers of mathematics should inculcate in children the inclination to develop strategies in the process of solving problems and to value its importance. However, the process of problem solving has not been given proper emphasis in schools, possibly due to the fact that teachers themselves are not very competent problem solvers and the burden of syllabus to finish and public examinations to prepare the students for.

REVIEW OF LITERATURE

ICT and mathematics problem solving

Amarasinghe and Lambdin (2000) described three different varieties of technology usage: I-using technology as a data analysis tool, II-using technology as a problem-solving/ mathematical modeling tool, and III-using technology to integrate mathematics with a context. Meanwhile researchers (Balacheff & Kaput, 1996; Kilpatrick & Davis, 1993) have discussed the impact of technological forces on learning and teaching mathematics.

Researchers argued that with the introduction of technology, it is possible to de-emphasize algorithmic skills; the resulting void may be filled by an increased emphasis on the development of mathematical concepts. Technology saves time and gives students access to powerful new ways to explore concepts at a depth that has not been possible in the past. The power of computers leads to fundamental changes in mathematics instruction. For example, the ability to build and run complex mathematical models, and easy exploration of "what if" questions through parametric variation has opened up new avenues for mathematics (Dreyfus, 1991). Furthermore, as Munirah (1996) observes, the teaching of calculus has seen a dramatic change now that activities such as exploring data or graphical data analysis have been revolutionized by the computer technology. The new role of computers is clearly expressed by Peters, O'Brian, Briscoe and Korth (1995).

It is also reported that weaker students often are better able to succeed with the help of technology, and thereby come to recognize that mathematics is not just for their more able classmates (Wimbish, 1992). Although there has been much written about the potential of technology to change how mathematics is taught, there does not seem to be much written about the how the use of technology changed students perception about mathematical problem solving. We are interested to know whether the use of technology could change students' perceptions of problem solving. However, we are aware that

students were not exposed and didn't have the experience of using technology during their school mathematics lessons.

Attitudes & Anxiety Towards Computer Use

We were also interested to investigate the students' attitudes and anxiety level as they actually use computers in this project. Attitude has been defined as an inclination to act or to be in a state of 'readiness' to act (Gagne, 1985). A positive attitude arises due to previous successful experiences or from a perception that success is possible. The Technology Acceptance Model (TAM) (Davis, Bagozzi, and Warshaw, 1989) suggests that attitudes towards its use directly influence intentions to use the computer and ultimately actual computer use. Davis et al. (1997) demonstrated that an individual's initial attitudes regarding a computer's ease of use and a computer's usefulness influence attitudes toward use and that training significantly improved the computer self-efficacy of both males and females (Torkzadeh, Pflughoeft & Hall, 1999). They also reported that training programs seemed more effective for male and female respondents with positive attitudes toward computers.

Computer anxiety can be understood to mean an uneasiness of the mind caused by the apprehension of things going wrong when using computers. Working with computers seem like an area more prone to feelings of anxiety such as irritation, frustration and bewilderment because users have to deal not only with correct use of software but at the same time be faced with technical computer problems (Fajou, 1997). According to Sieber et al. (1977) computer tasks also place great pressure on users due to the speed in which computers perform tasks that may prove to be overwhelming for those new to computers. "The level of anxiety that is initially evoked by a computer may be somewhat higher than when the same task is presented in a conventional manner" (Sieber et al, 1977).

Computer anxiety is prevalent amongst pre-service and practicing teachers, and many suffer at substantially high levels (Ayersman, 1996). Research suggests that computer experience is negatively related to computer anxiety (Koohang, 1989; Liu, Reed, & Phillips, 1992; Savenye, Davidson, & Orr, 1992; Reed et al., 1993; Maurer & Simonson, 1993-1994; Rosen et al., 1994; Necessary & Parish, 1996). As teachers gain experience with computers, anxiety is reduced. But even more critical to computer experience is the pleasantness (Gos, 1996) of these computer experiences, especially one's first encounter with computer technology (Häkkinen, 1994-1995).

Researchers (Loyd and Gressard, 1984; Howard & Smith, 1986; Glass and Knight, 1988; Necessary and Parish, 1996), support the theory of increasing computer experience will decrease computer anxiety. Parish and Necessary found that college students with little or no computer experience have more anxiety than those students that have experience. The results of their study revealed that "increased levels of computer experience and balance of weekly computer usage were both related with reduced levels of computer related anxiety". Glass and Knight (1988) determined those computer anxious students will become less anxious after an initial trauma period. By working through these fearful or frustrating stage students will gain experience, thus reduce anxiety. It is reasonable to assume that by increasing computer usage thereby experience, one would naturally reduce anxiety. There are however conflicting findings to these reports. Speir et al., (1997) and Fajou (1997) reported that subjects who exhibit computer anxiety prior to class are likely to be still anxious even after training. They further suggested that training may not be a mitigating factor for computer anxiety. One such measure that can be taken could be a one-to-one instructor and student training as an effort to overcome computer anxiety.

METHODOLOGY

The sample consisted of 131 student teachers attending a second-year Mathematics Teaching Methods Course at The School of Educational Studies, Universiti Sains Malaysia. These student teachers are from different basic mathematics qualification, gender and teaching experience. Ninety three percent of the sample was females (122) and seven percent (9) were males. Most of them are young student teachers ranging from 20 to 30 years of age with little or no teaching experience (92 %). More than eighty percent of the sample was of Malay ethnicity and the rest were of Chinese and Indian ethnicity. The sample averaged fairly in their background mathematics ability ranging from good (68%) to average (32%).

As part of the course requirement, the students were given a coursework in which they are required to prepare a three-part assignment. First, they are to search the World Wide Web (WWW) for at least three (3) lesson plans or articles on the use of technology, namely Excel to teach certain mathematics topics of their choice. The use of spreadsheet was suggested because of its user-friendly features and the availability of research done using it. Then they are to analyze the articles from the website and write a report on process of teaching and learning, giving attention to its strengths and weaknesses and how they would use the information to teach the topic in their own classrooms. They are also required to find two (2) articles in Mathematics Journals about the topic and include the findings in the report. Second, they are to prepare a creative and effective lesson to teach the topic they have chosen, based on the findings and analysis done in the report. This lesson should integrate the use of Excel in teaching the topic and must be prepared for a one period teaching and learning activity (forty minutes). Third, they are to carry out a micro teaching session lasting for fifteen to twenty minutes based on the lesson planned.

The Indiana Mathematics Belief Scales was administered at the beginning of the semester to find out about the students' beliefs about mathematics and problem solving. This instrument consists of items that elicit responses on beliefs about mathematical problem solving and the processes involved in it. This 30 item questionnaire recorded responses on a 4-point Likert scale ranging from strongly agree (4) to strongly disagree (1) and was administered before and after the course. Along with it, The Minnesota Computer Awareness Assessment (1979) instrument was also administered to look into the student teachers' attitude towards learning with computers. This 30-item questionnaire also recorded responses on a 4-point Likert scale ranging from strongly agree (4) to strongly disagree (1) and was also administered before and after the course. At the end of the semester, a part from The Indiana Mathematics Belief Scales and The Minnesota Computer Awareness Assessment, a post-evaluation was conducted to find out about the student teachers' perception about problem solving and how it has changed with the use of technology.

DATA ANALYSIS

The data was analyzed on based on the Indiana Mathematics Belief Scales that comprise five categories of beliefs regarding mathematics problem solving (word problems). The five belief categories are time spent on mathematics problems, understanding the steps in solving mathematical word problems, getting the answers, attitude towards word problems and effort put in to solve the problems. The five belief scales can be summarized as follows:

Belief 1: *I can solve time-consuming mathematics problems.* (Questions 1 – 6)

Belief 2: *There are word problems that cannot be solved with simple, step-by-step procedures.* (Questions 7 – 12)

Belief 3: *Understanding concept is important in mathematics.* (Questions 13 – 18)

Belief 4: *Word problems are important in mathematic.* (Questions 19 – 24)

Belief 5: *Effort can increase mathematical ability.* (Questions 25 – 30)

Table 1 shows the t-test for pre- and post-time scores. The results regarding time scores indicated that the initial score level were positive with a mean of 2.84 (see table 1).

	N	mean	df	t	Sig (2-tailed)
INITIAL TIME	115	2.84	114	-0.464	0.644
FINAL TIME	115	2.85	114	-0.464	0.644

* significant at 0.05 level

Although there is a slight increase in the mean of the time scores after undergoing this course (mean = 2.85), it was not statistically significant. This shows that although the student teachers agree that they can do lengthy mathematics problems, the use of technology did not alter their view on this matter significantly.

There is a notable increase in the mean of the steps scores after undergoing this course (mean = 3.04) and this was found to be statistically significant (see Table 2). This suggests that the student teachers agree that it is important to understand the steps involved in solving mathematics word problems and not merely follow simple step-by-step procedures.

Table 2: T-test for pre and post steps scores					
	N	mean	dfe	t	Sig (2-tailed)
INITIAL UNDERSTANDING STEPS	115	2.91	114	-4.510	0.000
FINAL UNDERSTANDING STEPS	115	3.04	114	-4.510	0.000

* significant at 0.05 level

Table 3 indicates the positive mean scores for getting answers to mathematics word problems. There is a significant increase in the mean (mean = 3.28) after undergoing the course and it is statistically significant. This shows that the teachers believe and agree that it is important to understand the concepts in mathematics rather than just following steps and being satisfied with getting the right answers.

Table 3: T-test for pre and post answers scores					
	N	mean	dfe	t	Sig (2-tailed)
INITIAL GETTING ANSWERS	114	3.03	113	-5.797	0.000
FINAL GETTING ANSWERS	114	3.28	113	-5.797	0.000

* significant at 0.05 level

When effort is concerned, the study revealed that the teachers believe and strongly agree that effort can increase mathematical ability. This is indicated by the increase in the mean of the effort scores (mean = 3.71) after the course and this was found to be statistically significant (see Table 4).

Table 4: T-test for pre and post effort scores					
	N	mean	dfe	t	Sig (2-tailed)
INITIAL EFFORT	62	3.54	61	-3.257	0.002
FINAL EFFORT	62	3.71	61	-3.257	0.002

* significant at 0.05 level

However, scores for attitude towards word problems in mathematics indicates a positive score that was not statistically significant (mean = 2.56). This suggests that the student teachers are uncertain about the importance of word problems in mathematics because their believe was not altered after attending the course. See Table 5.

Table 5: T-test for pre and post attitude scores					
	N	mean	dfe	t	Sig (2-tailed)
INITIAL WORD PROBLEMS	116	2.54	115	-0.557	0.579
FINAL WORD PROBLEMS	116	2.56	115	-0.557	0.579

* significant at 0.05 level

Data also revealed that the course had a positive effect on the student teachers' attitude towards computers. There is a notable increase in the mean of the attitudes scores after undergoing this course (mean = 3.01) and this was found to be statistically significant.

Table 6: T-test for pre and post attitude scores					
	N	mean	df _e	t	Sig (2-tailed)
INITIAL ATTITUDE	104	2.95	103	-1.867	0.065
FINAL ATTITUDE	104	3.01	103	-1.867	0.065

* significant at 0.05 level

On the other hand, the anxiety scores actually went up (mean = 3.13) after the course. Although, this was not statistically significant, it is something anticipated because this was a new experience for the student teachers in using ICT in teaching of mathematics.

Table 7: T-test for pre and post anxiety scores					
	N	mean	df _e	t	Sig (2-tailed)
INITIAL ANXIETY	96	2.88	95	-1.178	0.242
FINAL ANXIETY	96	3.13	95	-1.178	0.242

* significant at 0.05 level

CONCLUSIONS

This was a novice attempt to encourage future teachers of mathematics to integrate ICT in the teaching and learning mathematics. The findings reveal that the student teachers' perception about problem solving in mathematics actually changed with the use of ICT. Although they were quite apprehensive at first but they enjoyed the course and most importantly, they experienced a new perspective on mathematical problem solving. The role of ICT is seen as supporting and enhancing the ability of the student teachers to solve mathematics problems. Most importantly, it changed the way the teachers *see* the problems and devise ways of teaching mathematical problem solving using technology in order to offer new and powerful learning environment for our future generations.

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