Malaysian Secondary School Teachers Beliefs in Problem Solving

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Abstract

Problem solving is the highest level of cognitive skill. However, this skill seems to be lacking among secondary school students. Teachers’ beliefs influence the instructional strategies used for students’ learning. Hence, it is important to understand teachers’ beliefs so as to improve the processes for teaching problem solving. The purpose of this study is to investigate beliefs of secondary school teachers on problem solving and the extent these teachers are implementing problem solving in their teaching. A survey was conducted among 75 secondary school teachers teaching Forms 1 to 5 in Malaysian schools using a questionnaire formulated for this purpose. The beliefs of teachers and whether problem solving was used for instruction were investigated. The findings indicate that teachers are aware of the usefulness of problem solving but still emphasize memorization of facts and concepts for learning. These might be because they are unaware of how to teach problem solving. Hence, further research is required in developing instructional strategies for teaching problem solving skills to secondary school students.

Keywords: problem solving, teacher’s beliefs

INTRODUCTION

Today, more than in the past, one of the most important objectives of education is to foster students’ competences related to problem solving (Barak, 2013). Problem solving is important in honing students’ thinking, flexibility and creativity. It also encourages cooperative skills, teaches general problem solving skills and is a useful way to allow students to apply the knowledge learnt onto different situations (New Zealand Ministry of Education, 2010).

Problem solving is also an important skill for employability as employers require workers who are able to solve problems. Malaysian employers rank problem-solving skills most important after speaking and writing in English (Hamid, Islam, & Manaf, 2013). Problem solving is the highest level of cognitive skills. In Gagné’s hierarchy of learning, problem solving is at the highest level of complexity of learning, after discrimination and, concept learning and rule learning (Gagne, 1971). Problem solving requires higher order of thinking skills.

The National Education Philosophy (NEP) of Malaysia emphasizes the holistic development of the individual with a balance in the intellectual, spiritual, emotional and physical domains (Ministry of Education Malaysia, 2008). In line with Vision 2020, the education system is not only to produce a generation that is competitive but also well-equipped with problem solving skills to face challenges and issues.

However, problem solving skills seem to be lacking among Malaysian students. A quarter of our employers feel that our graduates lack problem-solving skills, thus contributing to graduate unemployment. According to the National Graduate Employability Blueprint 2012-2017, 25.9% fresh graduates demonstrate no ability to solve problems (Ministry of Higher Education Malaysia (MOHE),
Results from international assessments such as the Programme of International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS) have also indicated a declining trend, indicating that students in secondary schools also seem to lack problem-solving skills (Abdullah & Peters, 2015).

In response to this, one of the shifts of the Malaysia Education Blueprint 2013-2025 (Preschool to Post-Secondary Education) is to provide equal access to all students to an education system of an international standard (Ministry of Education Malaysia (MOE), 2013). This is required in the aspiration to produce students who are able to compete globally, and who possess both the knowledge and thinking skills (MOE, 2013). This means that the curriculum will be upgraded placing an emphasis on problem solving and thinking skills (MOE, 2013). This focus on thinking skills is also in the Malaysia Education Blueprint 2015-2025 (Higher Education) is for students to have thinking skills as they are able to appreciate diverse views, to think critically and be innovative, have problem-solving initiative, and an entrepreneurial skills.

Nevertheless, the development of problem solving and thinking skills among students depends on teacher’s instructional approach. Students develop and practice problem solving skills depends on whether the appropriate opportunities for students to acquire these skills are provided during instruction. Teachers’ epistemological beliefs on what knowledge is and how knowledge is delivered will determine what students learn (Pajares, 1992). Beliefs are important as they will affect the teachers’ behavior (Pajares, 1992). Hence, understanding that beliefs influences practice makes it important for the teaching process to be understood (Xenofontos & Andrews, 2012; Smith, 2014).

“Beliefs” are the “individual’s judgment of the truth or the falsity of a proposition, a judgment that can only be inferred from a collective understanding of what human beings say, intend, and do” (Pajares, 1992). This intention is influenced by substructures, such as educational beliefs, which are connected in a system. These substructures may be difficult to change when it has been incorporated long in the belief structure, and may be influenced by each other and contribute to the beliefs in the system (Pajares, 1992).

In this paper, teachers’ beliefs in problem solving are investigated to determine if problem solving was being implemented in schools. The following research questions are investigated:

i. What are the beliefs of teachers’ on problem solving skills?

ii. To what extent are teachers’ in schools are implementing problem solving in teaching?

The reason this research is needed is that although there has been much research on how teachers’ beliefs affect students learning and their achievement, very little has been done on teachers from multiple disciplines. A lot of the past studies on problem solving focus on teachers from a mathematical or scientific background (Thompson, 1992). This study fills the literature gap by determining to what extent teachers, in general, practice problem solving skills in their teaching.

Problem solving

According to (Jonassen, 2000), problem solving is considered as the most important cognitive activity in everyday life where people are required to solve problems. Problem solving is the process an individual experiences when the individual encounters an unknown, sees no immediate solution and is required to carry out several tasks or explore different approaches to achieve the solution (Xenofontos & Andrews, 2012). Learning environments focused on problem
solving bring about more learning and encourage students to utilize existing knowledge to explore possible solutions to a problem (Anderson, 1982). According to Merrill (2002), the problem solving process allows the students to gain new knowledge and to relate new knowledge with previous knowledge.

Early definitions on problem solving defined a problem as having three components: the ‘givens’, the ‘goals’ and the ‘obstacles’ (DeWitt & Alias, 2015). The givens in a problem is provided at the onset, and is a certain state with certain conditions, objects, and pieces of information; the goals are the desired or terminal state which is achieved by transforming from given to the goals; and the obstacles are the ways of changing the given state to achieve the goal of the problem (Mayer, 1983). However, this definition is limited to problems in the school curriculum and does not cover complex and ill-structured problems (DeWitt & Alias, 2015). A more current definition would be that problem solving is a process in finding a goal which is of value socially, culturally and intellectually (DeWitt & Alias, 2015).

According to the PISA’s 2012 results, Malaysian students scored below average and Malaysia was ranked 52nd out of 65 countries in Mathematics, Science and reading (Mozihim, 2014). In PISA 2009, Malaysia ranked 39 out of 44 countries on creative problem-solving (Abdullah & Peters, 2015). It can be seen that Malaysian students’ performance dropped within the years. When Malaysia first participated in TIMSS in 1999, its average student score was higher than the international average in both Mathematics and Science. In TIMSS 2011, Malaysia’s ranking in Maths fell from 20th in 2007 to 26th in 2011 while its ranking in Science dropped from 21st in 2007 to 32nd in 2011 (Ng, 2014). TIMMS and PISA result identified our students as possessing only inadequate mastery of basic mathematical and scientific concepts (Saifulbahri, 2014).

The results from these international assessments are enough to prove the struggle of Malaysian students in problem solving. Andreas Schleicher, acting Director of Education and Skills at OECD said “Today’s 15-year-olds with poor problem-solving skills will become tomorrow’s adults struggling to find or keep a good job” (OECD PISA, 2014). She is proven right by the current low graduate employment rate in Malaysia. In order to become a developed nation and improve the quality of our human capital, we need to immediately equip our students with problem solving skills.

An example of a past study related to the current study is by Bishaw, A. in 2011. The purpose of Bishaw’s study was to examine mathematics teachers’ beliefs and the application of their beliefs in their lessons. The study included 26 mathematics teachers teaching grades 9 and 10. The study showed that teachers have low level beliefs on problem solving and there is a high correlation between teachers’ confessed beliefs and their actual classroom practices in applying problem-solving teaching method.

Another study by Van MerriëNboer (2013) aims to clarify the term problem solving and to provide a preliminary answer to the question how real-life problem solving is best taught. It categorizes problem solving as a goal, a method, and a skill. This study disagrees with the claim that problem solving is not suitable for weak learners (New Zealand Ministry of Education, 2010). Van MerriëNboer says that “providing support in the early stages to novice learners is of utmost importance for helping them to develop problem-solving skills”. They may take a longer time and find it more complex compared to bright students but they will eventually master the method.

There are other difficulties encountered by educators in teaching problem solving. (New Zealand Ministry of Education, 2010). Firstly, teaching problem solving to students causes teacher discomfort (Roberts, 2010). Some teachers
do not really understand the concept of problem solving and they believe that they need to be first taught problem solving skills through a course before they themselves can teach it to students. Besides that, teaching problem solving brings about student insecurity. When students are first introduced to open-ended questions and expected to answer them with minimal scaffolding, students tend to feel insecure and less confident of their answers. Finally, it is obvious to teach problem solving, much preparation is required. Educators will have to experiment and come up with teaching strategies that best suit their students. The strategies and the questions to be discussed with the students must challenge them but not intimidate them. Gillies (2011) found that if teachers want to encourage higher order thinking and problem solving in their students, they then must carefully pick, plan and scaffold their questioning and teaching strategies for optimum results. To do this, teachers need to collaboratively devise a method time and it will involve time and discussion.

In Malaysia, the Ministry of Education Malaysia recently replaced the central assessment, Penilaian Menengah Rendah (PMR) with Pentaksiran Tingkatan 3 (PT3) in 2014. The questions set by Lembaga Peperiksaan Malaysia, Ministry of Education, did not emphasize much on problem solving. However, in PT3, a significantly higher number of problem solving questions were included, and a majority of schools dropped in performance (DeWitt & Alias, in press). This may also indicate that Malaysian secondary school teachers need to be equipped with good problem solving skills in order to be able to teach students to solve questions related to problem solving. For most of the teachers, it may be a dreaded task to move away from spoon-feeding their students to allowing them to explore on their own to synthesize information and find solutions to questions with minimal guidance from teachers. To be able to do this, again, they will have to incorporate problem solving skills into teaching and learning.

If we analyze the results of the first round of PT3 from the context of this study, one would say that it reflects poorly on the teachers’ problem-solving skills and their practice. This is because there was a huge gap in difference between the last PMR results and the first PT3 results. However, the drop in examination results may also be due to other factors such as the communication structure, the lack of time and preparation by the administrators, teachers and students (DeWitt & Alias, in press).

Teachers’ beliefs

Teachers’ beliefs influence teachers’ pedagogy. In a case study on first-language English teacher’s approach to teaching writing, it was also found that beliefs play an important role in influencing pedagogy in specific areas of the curriculum (Watson, 2015). This was exemplified when teachers who were observed while they were teaching were asked to explain their thinking processes and the impact of their belief on their teaching practice. The implication is that teachers’ beliefs must be taken into account when designing a contextualized approach to teaching.

The nature of knowledge and its influence on the beliefs of three New Zealand generalist primary teachers was studied by Anderson (2014). The study involved a total of 174 teachers in 40 schools who were surveyed to determine their beliefs. The results of his study indicate teachers' beliefs in science teaching and learning strongly influence teacher practice and knowledge.

The beliefs of the teacher influenced observed classroom practices in second language reading. A case study with observations and interviews for four weeks by Farrell & Ives (2014) allowed the teacher to express his beliefs. Even through the results of this study cannot be generalized, there seem to be a relationship between teachers’ beliefs and their practices.
Lera & Piquet (2014) carried out case studies on teachers in Spain and found that their beliefs on problem solving were closely related with their teachers' training programs (and therefore the educational stage) and teaching experience. This again proves that teachers' beliefs strongly influence teaching practice and also students learning. Zheng (2009) also found that teachers' beliefs are influenced by their teacher education programme and it has a great effect on how they teach. Therefore, these teachers may have been teaching the way they were taught to without actually reflecting on their practices.

METHOD

The sample of the study was randomly selected from secondary school teachers from two rural areas in Peninsular Malaysia: one in the northern region and the second in the southern region. The teachers agreed to participate on a voluntary basis and, there was no equality of gender emphasized. The questionnaires were distributed to secondary school teachers in the identified areas. A total of 75 questionnaires were returned.

The participating teachers were given the “Learning Skills Questionnaire”, a questionnaire comprising of 20 questions: 19 Likert-type questions and 1 open-ended question. The 19 Likert-type questions carry a statement each and the teachers are required to indicate their response on a spectrum of “1 = don’t know”, “2 = not true”, “3 = true” and “4 = very true”. An example of statement is “Problem solving is only used for mathematics”. The open ended question aims to find out if the teachers are able to use problem solving activities in their teaching. The questionnaire is in dual-language and the teachers are free to answer in either Bahasa Malaysia or English.

Data collection took place over the course of one month where questionnaires were given out according to different districts in the states. The data from the Likert-scale questions was analyzed based on percentage, standard deviation and mean. The open ended question’s responses were coded according to sub-themes.

RESULTS

Table 1 shows the distribution of the respondents' demographic related to subjects and the highest levels taught, years of teaching experience, computer skills and frequency of technology usage in teaching.

From a total of 75 teachers who were involved in the survey, 6 (8%) of the teachers teach more than one particular category. Subjects taught by the 12 (16%) teachers from the “other” category are History, Islamic Studies, Malay Literature, Geography, Information and Communication Technology, Integrated Living Skills, Health Education and Visual Arts Education. 66.6% of the respondent teach subjects of science and mathematics. With respect to the highest levels taught by the teachers, 14.7% of the teachers teach both Lower Secondary and Upper Secondary students while 2.6% of the teachers teach pre-university students or better known as Form 6 students.

The number of novice teachers with up to 5 years of teaching experience, and teachers with 6 to 10 years of experience were about the same (36.3% and 33.3 % respectively), while 22.7% have 11 to 20 years of experience, and 8% of the respondents have more than 20 years of teaching experience.

Most of the teachers evaluated themselves as skilled in computers (73.3%), followed by averagely skilled (21.3%), while only 4% evaluated themselves as very skilled. The distribution of respondents in regards to frequency of use of technology in teaching appears that 61.3% accounted for once a week or more often, 21.3% for once in two or three weeks, 10.7% for
once a month, 2.7% for once in 6 months and 4% almost never used technology in their teaching.

Table 1. Respondents’ demographic

<table>
<thead>
<tr>
<th>Teachers’ demographics</th>
<th>Numbers</th>
<th>Percentages (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects taught/ teaching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology/Chemistry/Physics</td>
<td>28</td>
<td>37.3</td>
</tr>
<tr>
<td>Mathematics</td>
<td>22</td>
<td>29.3</td>
</tr>
<tr>
<td>Languages</td>
<td>19</td>
<td>25.3</td>
</tr>
<tr>
<td>Others</td>
<td>12</td>
<td>16.0</td>
</tr>
<tr>
<td>Highest Level taught</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper Secondary</td>
<td>54</td>
<td>72.0</td>
</tr>
<tr>
<td>Lower Secondary</td>
<td>34</td>
<td>45.3</td>
</tr>
<tr>
<td>Primary</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Others</td>
<td>2</td>
<td>2.6</td>
</tr>
<tr>
<td>Number of years in teaching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-5 years</td>
<td>27</td>
<td>36.0</td>
</tr>
<tr>
<td>6-10 years</td>
<td>25</td>
<td>33.3</td>
</tr>
<tr>
<td>11-20 years</td>
<td>17</td>
<td>22.7</td>
</tr>
<tr>
<td>More than 20 years</td>
<td>6</td>
<td>8.0</td>
</tr>
</tbody>
</table>

In order to answer the research question on the teachers’ beliefs in problem solving skill, the data was analysed by computing mean score and the standard deviation (SD) (see Table 2). In general, teachers highly agreed that problem solving is needed for everyday life, with the highest mean score (mean = 3.51; S. D. = 0.52), followed by problem solving is a useful skill (mean = 3.49; S. D. = 0.53), provides a purpose for learning (mean = 3.40; S. D. = 0.52) and knowledge learnt through problem solving is remembered better (mean = 3.27; S. D. = 0.60). Although problem solving is useful for everyday life and for learning, many teachers seem to associate problem solving with mathematics (mean = 2.49; S. D. = 0.64).

In addition, although teachers believed that problem solving was important for learning and construction of knowledge, there were a large number who believed that memorizing facts (mean = 2.99; S. D. = 0.60) and concepts (mean = 2.96; S. D. = 0.60) were important for learning.

Table 2. Computed means for statements beliefs in problem solving

<table>
<thead>
<tr>
<th>No</th>
<th>Statements</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I solve problems in my everyday life.</td>
<td>3.39</td>
<td>0.52</td>
</tr>
<tr>
<td>2</td>
<td>Problem solving is needed for everyday life.</td>
<td>3.51</td>
<td>0.50</td>
</tr>
<tr>
<td>3</td>
<td>Problem solving gives a purpose for learning.</td>
<td>3.40</td>
<td>0.52</td>
</tr>
<tr>
<td>4</td>
<td>Problem solving is a useful skill.</td>
<td>3.49</td>
<td>0.53</td>
</tr>
<tr>
<td>5</td>
<td>Problem solving is only used for mathematics.</td>
<td>2.49</td>
<td>0.64</td>
</tr>
<tr>
<td>6</td>
<td>I need to think when I solve problems.</td>
<td>3.45</td>
<td>0.53</td>
</tr>
<tr>
<td>7</td>
<td>Learning facts are important for getting knowledge</td>
<td>3.32</td>
<td>0.60</td>
</tr>
<tr>
<td>8</td>
<td>Memorizing facts are important for learning</td>
<td>2.99</td>
<td>0.60</td>
</tr>
<tr>
<td>9</td>
<td>Memorizing concepts are important for learning</td>
<td>2.96</td>
<td>0.60</td>
</tr>
<tr>
<td>10</td>
<td>Applying concepts to other situations are important for learning</td>
<td>3.37</td>
<td>0.54</td>
</tr>
<tr>
<td>11</td>
<td>I can usually find an answer when I use problem solving</td>
<td>3.12</td>
<td>0.61</td>
</tr>
<tr>
<td>12</td>
<td>I enjoy problem solving activities</td>
<td>3.12</td>
<td>0.57</td>
</tr>
<tr>
<td>13</td>
<td>Learning through problem solving is more meaningful than learning facts</td>
<td>3.17</td>
<td>0.62</td>
</tr>
</tbody>
</table>
In order to determine to what extent teachers' in schools are implementing problem solving in teaching, an open-ended question was used. Only 50 or the 76 respondents (65.8%) answered this question on teachers' ability to use problem based learning (PBL) in their teaching and their reasons. Out of 76 teachers, only 50 responded to this question. Two out of the 50 teachers who answered (4.0%) said they are unable to use PBL in the classroom due to shortage of time and also the attitude of students who are too dependent on the teachers for answers.

The remaining responses of the other 48 teachers (96.0%) who responded positively were analyzed and grouped into themes of universality, motivation, hands-on-experience, interaction and personal gain.

Universality

The respondents noted the usefulness of PBL in life. They responded: “PBL helps to students to connect new knowledge with prior knowledge”, “helps to students to relate the problems to real life situations”, “teaching and learning more meaningful for both the teachers and the students.”

Motivation

Some teachers noted the advantages of employing problem solving in class for learning. This was because it “encouraged students to apply HOTS”, and “reduced students boredom in class compared to traditional teaching methods.”

Hands-on experience

Problem solving enabled students to be hands-on with their learning: “Students had the opportunity to explore different methods and solutions for a given problem.”

Interaction

Problem solving encouraged interaction and this allowed for higher level thinking as “students develop better communication with their peers and are encouraged to think outside the box.” This in turn increases motivation as well: “students’ engagement in class is increased” and “a student-centered learning environment is encouraged.”

Personal gain

Problem solving enables the student to gain personally: “Students retain the knowledge learnt for a longer time,” and “understand the concept better.”

DISCUSSION

This study explores the beliefs of teachers on problem solving skills and to what extent these teachers in schools are implementing problem solving in teaching. People's beliefs strongly affect their behavior and beliefs cannot be directly observed or measured but must be inferred from what people say, intend, and do (Pajares, 1992). Hence, the findings of the study seem to indicate that teachers believe that problem solving was a useful skill for life and could assist learning. However, there were a number who seem to believe that problem
solving was confined to learning mathematics. In addition, the emphasis on memorizing for learning facts and concepts may seem to indicate that teachers preferred a traditional teacher-centered approach rather than allowing their students to construct knowledge from the problems that they encountered in life.

However, it is not known to what extend these teachers implement problem solving in their teaching and could only be studied from the extent of their intention and practice (Pajares, 1992). Only 63.2% of the respondents seem to indicate that problem solving was used in their class, and 2.6% claimed they did not use problem solving. Most likely the remainder of the respondents (34.2%), did not use problem solving as they did not want to respond negatively. In this study, age of the teacher may not be an influence of the belief in problem solving as the respondents were from the different age groups.

It is important to investigate teacher beliefs in problem solving as their beliefs may influence their practice in teaching (Anderson, 2014; Farrell & Ives, 2014; Lera & Piquet, 2014). Hence, there does seem to be some problem solving activities being carried out by the teachers, and this may have been influenced by the teacher training programmes they had attended (Lera & Piquet, 2014; Zheng, 2009). Hence, further studies could be done to determine to what extend teachers’ training programmes influence the practice of implementing problem solving in schools.

Teachers training for teaching problem solving skills among students may need to be extended to subjects other than mathematics, so as to further strengthen teachers’ beliefs in the use of problem solving. Instructional models and strategies for teaching problem solving skills in other subjects is required for teachers to be confident and apply these strategies in the classroom.

The importance of problem solving is required to ensure that our Malaysian graduates would be able to think critically and compete globally (MOE 2013, MOHE, 2012). It is hoped that this could be reflected through improved PISA and TIMMS results (Abdullah & Peters, 2015). In addition, the centralized national examinations such as Pentaksiran Tingkat 3 (PT3) will incorporate progressively more questions to test higher order thinking each year. Hence, the need for models and strategies to teach problem solving in all subjects becomes increasingly important.

There are several limitations to this study. The sample of the teachers is small and limited to only two states in Malaysia and may not be representative of all teachers in Malaysia. In addition, the sample was not specific to any subject area.

The results of this study may only represent the teachers’ belief for that particular point in time when they had the necessary knowledge to answer the questions (Anderson, 1998). In addition, it is assumed that the teachers responded to the statements honestly (Wolf, 1997). Teachers’ beliefs may change in future depending on training they have received and other external factors in the school and administrative environment. However, these findings are also useful as a baseline for future research.

CONCLUSION

Malaysian secondary school teachers’ seem to indicate that they believed problem solving skills were useful for life. However, the extent in which teachers are implementing problem solving in teaching has yet to be determined. Results from both the national examinations such as PT3, and international assessments such as TIMMS and PISA seem to indicate a need for the Malaysian education system to be improved for our students to be at par with students of other countries (Abdullah & Peters, 2015).
The findings of this study provide implications for the policy makers, researchers and educators. There is a need for more teacher training in preparing teachers for teaching problem solving. An instructional model focusing on developing problem solving skills needs to be developed to help the teachers teach problem solving skills. In turn, a holistic education where students are taught problem solving skills for everyday life from a young age, instead of only in the secondary schools, is required. This would produce wholesome individuals who are skilled and knowledgeable society, and able to solve problems in life and at the workplace, in line with the National Philosophy of Education of Malaysia.

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