THE LEVEL OF PROBLEM SOLVING ABILITY AND ITS RELATIONSHIP WITH METACOGNITIVE SKILLS AMONG FORM FOUR PHYSICS STUDENTS IN SECONDARY SCHOOLS IN JOHOR

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ABSTRACT

This paper respresents part of the findings of the short term research project on Metacognition funded by Research Management Centre (RMC) Universiti Teknologi Malaysia. The aim of this paper is to highlight part of the findings of the main study which was to determine the level of problem solving ability and its relationship with metacognitive skills among form four physics students in secondary schools in Johor. In the study, a sample of 1 300 student respondents were selected from nine districts in Johor. The districts are Batu Pahat, Muar, Kota Tinggi, Pontian, Johor Bahru, Segamat, Mersing, Kulai and Kluang. Two well-validated instruments namely Metacognitive Skills Questionnaire (MSQ) and Physics Problem Solving Ability Test (PPSAT) were conducted and the data collected were analysed using SPSS software. Descriptive statistics- means, standard deviation, percentages and inferential statistics one way ANOVA and Pearson-r were used for interpreting the data. Findings of the study revealed that the level of problem solving ability among form four physics students in Johor was moderate. Furthermore, there was a weak but significant correlation (α=0.01) between metacognitive skills and Physics problem solving ability of the respondents. However, students with high metacognitive skills had mean score on PPSAT which was significantly different from those students with moderate and weak metacognitive skills (α=0.01). There was no significant difference in Problem solving skills between students with moderate and weak metacognitive skills.

INTRODUCTION

Problem solving can be defined as finding solutions to challenging or unfamiliar situations or unanticipated difficulties in a systematic manner (Curriculum Development Centre, 2005). It is one of the objectives of Physics Curriculum (Curriculum Development Centre, 2005). Indeed, it was one of the three higher order thinking skills in a Thinking Skills and Thinking Strategies (TSTS) Model in Science (Curriculum Development Centre, 2005). Based on this statement, it shows that problem solving is one of the most importance thing that need to be developed by students.

The use of drill and practice will only accustom the students with the format and not on the problems. Thus, students can only answer the problem that they are familiar with the format. However, if they are faced with problem with different format (adaptation problems), most of the students do not know how to solve them even though they are of same concept. Drill and practice

in school are reinforcement to students where it reminds of Behaviorism. The Education Ministry also has realized that the current system in primary and secondary schools is quite burdensome to students and to a certain extent fails to reflect their capabilities. Indeed our Minister of Education, Hishammudin Tun Hussin and his Ministry are looking for best ways to overhaul the heavily examination-oriented system functioning in schools (The Star Online, September 17, 2006).

Most of the recent studies on problem solving are focused on cognitive aspects which are related to students' thinking. Starting on the cognitive development by Piaget until up to the theory of problem solving, the problem raised by Nobel Prize Award, Simon (Newel & Simon, 1972) was that thinking in problem solving can be assumed to be similar to computer operations. All of them are focusing on the higher thinking skills among students. As Flavel introduced about metacognitive in 1971 (Kluwe, 1982), most of the current studies are moving from behaviorist to cognitive and to the new study called metacognitive (Seroglue & Koumaras, 2001). This paper reports only three findings of the whole research objectives of the project.

RESEARCH OBJECTIVES

1.1 To determine the levels of problem solving ability among form four physics students in secondary schools in Johor
1.2 To determine the relationship of problem solving ability with metacognitive skills among form four physics students in secondary schools in Johor
1.3 To determine the influence of metacognitive skills on problem solving ability among form four physics students in secondary schools in Johor

RESEARCH QUESTIONS

1.1 What are the levels of problem solving ability among form four physics students in secondary schools in Johor
1.2 What is the relationship between problem solving ability and metacognitive skills among form four physics students in secondary schools in Johor
1.3 What is the influence of metacognitive skills on problem solving ability among form four physics students in secondary schools in Johor

METHODOLOGY

Research design

This research employs a quantitative descriptive design.

Sampling

The sampling used in this research is simple random cluster sampling of students from selected schools in Johor. And 1300 respondents were selected from nine districts in Johor which are Batu Pahat, Muar, Kota Tinggi, Pontian, Johor Bahru, Segamat, Mersing, Kulai and Kluang. The sample consisted of 625 male and 660 female while 15 respondents somehow did not state their gender thus considered as missing values in the final data analysis.

Instruments

Two well-validated instruments namely Metacognitive Skills Questionnaire (MSQ) and Physics Problem Solving Ability Test (PPSAT) were conducted in this research. PPSAT contains of four subjective questions from the topics of linear motion. The PPSAT instrument was tested on 36 physics students (17 males,19 females) in one of the schools in Johor Bahru (Fatin, 2004). Initially PPSAT consisted of 20 objectives questions on mechanics based on the SPM syllabus were tested but was found unsuitable. Finally only 4 questions with Index Difficulty Level of between 0.25 and 0.75 and Discrimination Index of greater than 0.2 were selected. The 4 questions were then refined and retested on the same respondents three weeks after the first test (Best & Kahn, 1998).The Cronbach Alpha Coefficient was found to be 0.80. while, MSQ consisted of 27 Likert-5-point scale items which comprise of eight items of monitoring, ten items of evaluating and nine component of regulating. The items were developed and innovated from questionnaire used by O'Niel & Brown (1997) dan Namsoo (1998). The validity of the instruments were checked by two lecturers who are experts in the field. The translated and validated items were tested on the same 36 respondents and Cronbach Alpha Coefficient was found to be 0.92.

Research procedure

Both instruments MSQ and PPSAT were conducted simultaneously. Time to complete all the questionnaire was estimated to be one hour. To determine the level of problem solving abilities, there are five level to be considered as follows; Excellent, Good, Moderate, Weak and Very weak (refer to table 1). MSQ paper was evaluated by four persons namely project leader, two researchers and one Physics teacher. Pearson correlation was used to determine the interrater reliability between the four evaluators. For this purpose, 25 respondents had been identified and they were not taken to be respondents in the real study. Then, interrater reliability among evaluators was found to be significant at alpha level .01 for all the four (4) questions(Seth, Fatin and Marlina, 2006).

The range of Pearson correlations among the evaluators for questions 1, 2, 3 and 4; are 0.801-0.943, 0.699-0.973, 0.726-0.966 dan 0.628-0.866 respectively. From the result, Pearson Correlation for every question is high and the difference of range value among evaluators is small. Hence, the marking system among evaluators were quite uniform for every question (Seth, Fatin and Marlina, 2007).

Table 1: Range of mean score to determine the level of problem solving abilities

Score (%)	Level
80-100	Excellence
60-79	Good
40-59	Moderate
20-39	Weak
0-19	Very Weak

RESULTS AND DISCUSSIONS

Table 2: The level of problem solving ability among form four physics students in secondary schools in Johor

Variable	Min (%)	Level
Total (N=1300)	46.3	Moderate
Male (N=625)	48.0	Moderate
Female (N=660)	45.3	Moderate
City (N=928)	45.9	Moderate
Rural (N=372)	47.1	Moderate

Table 2 shows the level of problem solving ability among form four physics students in secondary schools in Johor. From the table it shows that all of the respondents in this research has moderate level of problem solving with the percentage of means 46.3%. The level of problem solving ability among males, females, school location are all at moderate level.

Table 3: Correlation Pearson of problem solving abilitywith metacognitive skills among form four physics students in secondary schools in Johor

Variable	N	R	Sig.
Metacognitive	1146	.161	.000
Problem solving	1146		

Table 3 shows that there is a low but positive relationship between metacognitive skills and problem solving ability with the coefficient of .161 at alpha level .01. Thus, as the metacognitive skills among students increase the level of problem solving will also increase.

Table 4: One-way ANOVA of correlation between metacognitive skills and problem solving ability

Problem Solving	df	SS	MS	F	Sig.
Between group	2	8336.433	4168.216	11.283	.000
In group	1143	422235.91	369.410		
Total	1145	430572			

The Pearson Correlation only provides information on the relationship between metacognitive skills and problem solving ability without indicating whether metacognitive skills really influence problem solving ability. In order to justify its influence on problem solving the scores on problem solving were categorized into levels. The score range of (70-100%) was categorized as “good” and was coded as 3, (40-69%) was categorized as “moderate” snd was coded as 2 and score range (0-39%) was categorized as “weak” and was coded as 1. One-way ANOVA (table 4) was used with metacognitive skills as dependent variable. It was found that respondents with “good” level of problem solving ability had significantly higher mean in metacognitive skills compared to respondents with “weak” metacognitive skills at alpha level .05. There was no significant difference in metacognitive skills between “good” problem solvers and “moderate” problem solvers and between “moderate” and “weak” problem solvers. Therefore in this study metacognitive skills did influence problem solving ability.

Conclusions

The most important finding from this research is metacognitive skills did influence the students’ problem solving ability. Based on the data(N=1300), the students has moderate level of problem solving with the percentage of means 46.3%. Correlation Pearson-r shows coefficient of

.161. It shows that there is a low positive relationship between metacognitive skills and problem solving at α=0.01. Initially Fatin (2004) using respondents in Johor Bahru district (N=389) found a weak positive correlation between metacognitive skills and problem solving skills. The consistency of significant realtionship was further attested by taking samples from Batu Pahat, Muar, Pontian and Kota Tinggi (N=816).The realtionship was again found to significant at α=0.01 with Pearson's coefficient of r=0.210 (Seth, Fatin and Marlina, 2005). Thus, as the metacognitive among students increase the level of problem solving will increase. Further it was found that respondents with "good" level of problem solving ability had significantly higher mean in metacognitive skills compared to respondents with "weak" metacognitive skills at alpha level .05.

Findings of this research seem to suggest, that Physics teachers should emphasise the development of metacognitive skills among students which would enhance students' problem solving ability. The metacognitive skills, not only make the students understand about the concept better but can inculcate greater interest towards Physics. In contrast, it will avoid method of teaching Physics that emphasises on memorization of formulae and execution of mathematical algorithmic operations only.

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