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ABSTRACT

Efforts to improve teaching and learning process in *Kapita Selekt Matematika Sekolah* subjects for university students have been continually carried out. Reciprocal teaching is one of teaching models in which a group of students present their understandings of a concept while their instructor and other students are giving their responses and arguments related to the concept in discussion. This teaching model had been implemented in *Kapita Selekt Matematika Sekolah II* subject on the topics: Sequences and Series, Polynomials, Solid Geometry, Composites and Inverses of Functions, Equations and Inequalities of Logarithms, Exponents, and Absolute Values. Applying the descriptive method, the results of the study showed that it was only on the topic of Sequence and Series did more than 80% of the students earn scores of equal to or higher than 75. Most of the students made mistakes in other topics. These mistakes were originated from the students' inability to apply their understandings to the problems at hand and their inability to identify conditions for the concepts in the given problems.

Key word: Reciprocal Teaching

INTRODUCTION

According to Wahyudin (1999) in his research about school mathematics mastery of the students majoring in mathematics education, there were hitherto such students who had low mastery in school mathematics. The research also revealed that approximately 30% of the contents of mathematics curriculum at the time were not perceived adequately by about 50% of the students.

Some contents not adequately perceived by the students majoring in mathematics education were related to, among others, the concepts of: Functions, Exponential Inequalities, Plane Geometry, Solid Geometry, Mathematical

Induction, Logics, and Trigonometry. In the research it was also found that there were still some misperception and misconception on part of the students in terms of the concepts stated above.

Wahyudin (1999) proposes an idea that because school mathematics materials are ones that should be mastered profoundly by students majoring in mathematics education that thereby will be future mathematics teachers, then the teaching staff of *Kapita Selekt Matematika Sekolah* subjects are expected to be more careful and comprehensive in making the students learn the materials. Accordingly, they need to find a more refined instructional strategy than the strategies used in the past in order to bring about their students' optimal achievement in the subjects. Amongst many other potential instructional strategies or models, an interactive teaching model, particularly the reciprocal teaching, is predicted to be one that is relevant and able to fulfil such expectation.

After administering a reciprocal teaching model, how well is the students' achievement in the subject *Kapita Selekt Matematika Sekolah II*? Do the students still make mistakes in solving post-test items for the subject?

REVIEW OF RELATED LITERATURE

Interactive Teaching

As an alternative format to the traditional teaching methods, interactive learning provides learners with situations that push the boundaries of their abilities and actively engage them in tasks. It also gives students an opportunity to be learners as they come to master a task (or part of one) and, once they have achieved mastery, to be teachers of those who are still learning. The research of Brown, et al. (1991) indicates that problems that are too difficult at first for students to handle on their own later become problem types they can solve independently when they have first worked on them in a small group setting. This kind of interaction is called *reciprocal teaching* because both the teacher and the student(s) are teachers and learners.

Reciprocal teaching and scaffolding (in which the 'expert', teacher, or parent decreases assistance and sets up tasks at increasingly challenging levels in

response to a student's increased skills and understanding) also enable students to learn a body of coherent, usable, and meaningful knowledge within their zone of proximal development (the distance between what students can do on their own and what they are capable of doing with assistance), and "to develop a repertoire of strategies that will enable them to learn new content on their own" (Brown, et al. 1991, 150).

Reciprocal Teaching

The concept of reciprocal teaching was originally developed by Palincsar in 1982. An early development of the teaching model was applied in a pilot study (Brown & Palincsar, 1982), where teacher and student took turns leading a dialogue concerning sections of a text. The procedure was similar to, but more extensive than, the reciprocal questioning intervention used by Manzo (1968).

Later, the concept was refined and operationalized by Palincsar and Brown in 1984. Palincsar and Brown (1984) identified four basic strategies that help students recognize and react to signs of comprehension breakdown: Clarifying, Predicting, Questioning, and Summarizing. These strategies serve dual purposes of being both comprehension-fostering and comprehension-monitoring. All of the strategies take place within the context of small-group collaborative investigation, which is maintained, monitored, and scaffolded by the teacher or tutor. In fact, reciprocal teaching was developed as a technique to help teachers bridge the gap for students who demonstrated a discrepancy between decoding skills and comprehension skills (Palincsar, Ransom, & Derber, 1989).

One of the goals of reciprocal teaching is joint construction of meaning, in which its reciprocal nature forces student engagement and teacher modeling provides examples of expert performance. Reciprocal teaching experience enables the students both to learn a body of coherent, usable knowledge and to develop a repertoire of strategies that will enable them to learn new content (Brown, et al., 1991, 150).

In reciprocal teaching model the teacher plays a role as a member of any group, but he or she does have an explicit instructional goal. It is part of the

teacher's responsibility to engage in deliberate scaffolding activities when he or she works with current discussion leaders in an attempt to improve their level of participation. Thus, reciprocal teaching is both a cooperative learning group jointly negotiating and understanding task and a direct instruction forum wherein the teacher attempts to provide temporary scaffolding to support tentative strategies of the students leading their small groups. The idea of scaffolding is for the teacher to take control only when needed and to hand over the responsibility to the students whenever they are ready. Through interactions with the supportive teacher, the students are guided to perform at an increasingly challenging level. Meanwhile, accordingly, the teacher gradually fades into the background and acts as a sympathetic coach, leaving the students to handle their own learning. However, the teacher is always monitoring the discussions and is ready to take control again when understanding fails. (Brown, et al., 1991, 139-41).

RESEARCH METHODOLOGY

Research Method

The research was intended to examine empirically about the students' level of achievement and to describe mistakes (misperception and misconception) in their responses to *Kapita Selekt Matematika Sekolah II* semester examination test items after been taught using reciprocal teaching model. Therefore, the method used in the research was mixed-method, which is a combination of quantitative and qualitative (descriptive) methods.

Research Instruments

The research made use of two types of data, the quantitative and qualitative data. Both data were collected using two instruments, a pretest and an achievement test (the semester examination). The pretest was administered to assess students' prior understanding of the essential concepts of school mathematics. The achievement test was conducted to reveal the percentage of the students earned scores of equal to or higher than 75. Meanwhile, some descriptions of the working process and

mistakes carried out by the students in understanding essential topics were based on the percentage of the students that could meet the indicator of each test item.

RESULTS AND DISCUSSION

As mentioned above, the instructional format applied to *Kapita Selekt Matematika Sekolah II* lessons was reciprocal teaching, where students taking the subject were divided into several small groups in which they learned and discussed essential concepts of school mathematics. Each group of students presented their understanding of a particular topic of school mathematics. The students were required to understand the basic concepts contained in each topic and be able to develop new strategies in handling the problems related to it. Interaction between students in negotiating their understandings proved to be beneficial in the process of construction of meaning about the concepts being discussed. Meanwhile, the teacher took a role of a group member and at the same time kept him- or herself aware of the explicit instructional goal. One of the teacher's responsibilities in reciprocal teaching process was to engage in the scaffolding activities that encourage students' active participation.

After the reciprocal teaching treatment on a number of topics, the students were given an achievement test (the post-test). A general description of the test results are shown in the following table.

TABEL 26 Students' Learning Achievement

	TEST ITEM					
	1	2	3	4	5	6
SD	3.11	4.27	2.93	3.75	2.67	3.94
\bar{X}	8.68	5.15	4.86	3.07	4.0	6.0
N(75)	50 (84.75%)	26 (44.07%)	11 (18.64%)	8 (13.56%)	4 (6.78%)	35 (59.32)

Note: N(75) = the number of students scored ≥ 75 .

The average score on *Kapita Selekt Matematika Sekolah II* final examination was 52.94 with a standard deviation of 21.96. Amongst the topics presented, the topic of Sequence and Series was the only one achieved by more than 80% of the students with scores of ≥ 75 . On the topic of Logarithmic

Equations, 59.32% of the students earned scores of ≥ 75 . The kind of mistakes made by many students was inability to apply logarithmic properties.

The topic about which most students did not understand was the Inverse Functions. It was only 6.78% of the students earned scores ≥ 75 . Most of the students made mistakes in applying the condition for a function to have an inverse on a bounded interval.

In terms of Trigonometry, the form $a\sin 2x + b\cos 2x$ was mastered well by 13.56% of the students with scores of ≥ 75 . The mistake made by many students on the topic was related to understanding of the concept in changing the form $a\sin 2x + b\cos 2x$ into the form $k\cos(2x - \theta)$. Meanwhile, on the topic of Solid Geometry, there were 11 out of 59 students (18.64%) that earned scores of ≥ 75 . Most of the students had not adequately understood the concept of drawing the cross-section of a solid figure and a plane. It was also the case with the concept of the distance from a given point to a plane; they were not able to apply the concept in determining the correct line which is located on the plane.

The last topic included in the achievement test was Polynomials (the Remainder Theorem). It was 44.07% of the students earned scores of ≥ 75 . The remarkable mistake made by the students in applying the Remainder Theorem was their inability to understand correctly the concept of division of polynomials using the theorem such that many of them found it difficult to determine necessary values to find the remainder for the division.

CONCLUSIONS AND SUGGESTIONS

A. Conclusions

Based on the research results stated in the previous section, we highlight the following conclusions:

- a. In general, most of the students found difficulties in working on the final test particularly on the essential concepts of polynomials, solid geometry, trigonometry of the form $a\sin 2x + b\cos 2x$, composites and inverses of

functions, and logarithmic equations. The topic of Sequences and Series is the only topic achieved by 80% of the students that scored ≥ 75 .

- b. The most striking mistake the students made in applying the concepts in the topic of Polynomials was their lack of ability to correctly understand the relationship between polynomials division and the Remainder Theorem such that many of them found difficulties in determining the values necessary for calculating the remainder of the division. Meanwhile, on Solid Geometry, many students made mistakes in determining two intersecting lines, one of which is on the plane and the other one is on/in the solid figure. In addition, many students did not adequately understand how to determine the projection of a line on a plane.
- c. On the topic of Trigonometry, many students made mistakes in changing the form $a\sin 2x + b\cos 2x$ into the form $k\cos(2x - \theta)$. Meanwhile, the mistake the students made about functions was their lack of ability to determine the domain (interval) of the function, on which the inverse of the function is also a function. In terms of logarithms, many students were not able to apply logarithmic properties to the problem given in the achievement test.

B. Suggestions

Based on the research results that are summarized in the conclusions section, we propose the following suggestions to improve the instructional process of *Kapita Selekt Matematika Sekolah* subjects:

- a. The topics for which the students' achievement are below the score of 75, for example, Polynomials, Solid Geometry, Inverse Functions, the graph of the function of the form $f(x) = a\cos x + b\sin x$, and logarithmic equations, should be given so much emphasis and attention from the teaching staff.
- b. For the topic of Polynomials, the relationship between the division of polynomials and the Remainder Theorem should be discussed thoroughly.
- c. The point that should be given special attention in the topic of Solid Geometry is the application of its essential concepts.

- d. A problem that can contrast a concept with other concepts is very important in building understanding of the concept being discussed.

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