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Tracing for the problem-solving ability in advanced calculus class based on modification of SAVI model at Universitas Negeri Semarang

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Abstract. There were many ways of solving the problem offered by the experts. The author combines various ways of solving the problem as a form of novelty. Among the learning model that was expected to support the growth of problem-solving skills was SAVI. The purpose, to obtain trace results from the analysis of the problem-solving ability of students in the Dual Integral material. The research method was a qualitative approach. Its activities include tests was filled with mathematical connections, observation, interviews, FGD, and triangulation. The results were: (1) some students were still experiencing difficulties in solving the problems. (2) The application of modification of SAVI learning model effective in supporting the growth of problem-solving abilities. (3) The strength of the students related to solving the problem, there were two students in the excellent category, there were three students in right classes and one student in the medium group.

1. Introduction

Five primary math skills mastered by students, namely problem-solving abilities, reasoning and proof ability, mathematical communication ability, mathematical ability connections, and representation ability. Five necessary capabilities need to be known and mastered by the students of the teacher candidate.

Skills in solving these problems, developed among others by Polya, Krulick & Rudnick, Tambychik & Thamby, Wismath, and others [1-4]. According to, a math problem can be used as a means to improve the ability of a problem solving for the student if: (1) the prerequisites material for finding the solution of the problems had been already discussed, (2) the solution of the problem affordable by students, (3) The algorithm had been not explained by the teacher yet, and (4) there was the student's will to resolve the problem. So, not all problems can be used as a tool to improve problem-solving abilities.

Thus, lecturers need to implement a learning model that was expected to be supporting the growth of the student's problem-solving abilities. Among of them, for example, the learning model of SAVI. Therefore, research on disclosure and tracking of problem-solving skills of students of Mathematics Education of UNNES implemented through the application of SAVI and its modifications.

Caused by constraints of the time, costs, and the extent of the problem, so for this study, the subject matter was limited only to the topic of Dual Integral. Topics Dual Integral exists on Advanced Calculus courses.

The research problems were as follows. (1) How was an example/model of a question on the subject of Dual Integral containing mathematical connection that can foster the problem-solving



ability of students? (2) How to explore the effectiveness of SAVI learning model on the topic of Dual Integral in encouraging problem-solving skills of students of Mathematics Education, Universitas Negeri Semarang (UNNES) of Indonesia? (3) How can explore the problem-solving abilities of students of Mathematics Education UNNES - Semarang on the subject of post-implementation SAVI and its modifications on Dual Integral?

The purposes of this research were as follows. (1) Generate a sample/model of the subject matter of the Dual Integral containing mathematical connection that fosters student problem-solving ability. (2) To determine the effectiveness of the implementation of SAVI and its modifications on the topic of Dual Integral in promoting problem-solving skills of students of Mathematics Education, UNNES. (3) To obtain trace results on problem-solving ability of students of Mathematics Education, UNNES - Semarang on the subject of post-implementation SAVI and its modifications on Dual Integral.

2. Methods

2.1. Applications SAVI and its Modifications

Sapti and Suparwati [5] stated that the order of application of SAVI learning models, including Somatic, Auditory, Visualization, and Intellectually. The explanation is as follows. (1) Somatic, learning is done by bodily, i.e., education begins with the move and does something (no students who are passive and are all trying to do the problems, without exception). (2) Auditory, namely learning followed by a talk and hear (discussion in small groups). (3) Visualization is a study conducted by observing and drawing geometric. It is necessary spatial ability. (4) Intellectually, the learning done by using intelligence to reflect on an experience and discover relationships (the ability to connect math required), plan and implement activities to get a solution the problem/point.

Also, Botty *et al* [6] a model of learning that can improve students' ability to solve the problem either in mathematics and other subjects such as Geography. Applications SAVI and its Modifications, the meaning is SAVI plus PBL.

In applying of the pure PBL, wrote that the teachers or lecturers could apply the following syntax. (1) The teacher prepares a matter of meeting the requirements as a matter to uncover the student's ability to solve problems, i.e., the algorithm has not been notified to the students. (2) The teacher explains the subject matter. (3) Teachers provide exercises that are routine by the material covered. (4) The teacher asks the students weeks to work on the problems that used to reveal the students' skills in problem-solving. (5) After the teacher finished checking the work of students, teachers discuss difficulties in front of the class settlement.

The importance of this SAVI plus PBL or applications SAVI and its Modifications learning model implemented in the school. Problem-solving ability, if developed to foster a valuable skill in itself, an informed way of thinking, and students work not only as a means to achieve the goal of finding the right answers.

2.2. The sequence in Problem Solving

There were many types of abilities in mathematics that can be learned. For a long time, Demircioğlu and Selçuk [7] wrote that problem-solving skills become the focus of learning math. However, it has not seemed real effort of teachers to improve their students' problem-solving skills. Problem solving was a process which requires high-level cognitive skills. Then, stated that it was needed to improve students' skills of problem-solving [8-9].

There were two critical issues in growing ability to solve mathematical problems, namely the problem of finding and proving a problem [10-11]. Associated with the order of how to solve the problem, many experts discussed, some of which were as follows: Polya, Krulick & Rudnick, Tambychik, and Cañadas.

Based on the opinions of the experts above, the researcher has concluded, choose, and set up of six steps to resolve the problem, namely:

- (1) *reading and understanding,*
- (2) *analyze and planning,*
- (3) *organizing strategy or organization on particular cases,*
- (4) *Solving the problem,*
- (5) *confirmation of the process, and*
- (6) *acceptance of the answer.*

Phase in reading and understanding, the students read them carefully and then began to understand. Ability in reading and understanding characterized by the ability of students to write down what is known and what is asked correctly.

The phase of analysis and planning, students begin to analyze the results of thinking and then began to plan its completion strategy. Ability to analyze and preparing indicator/characterized by the ability of students to write down the formula that will be used correctly, or write-solving procedures used, or create images to facilitate the settlement of the problem.

Phase in organizing strategy or organization on particular cases based on specific cases contained in the matter, the students began to organize in sequence, and both the plan that has been chosen. Ability in organizing strategy or organization on particular cases are marked with the student's ability to write and sort the formulas. That is to be used in a logical and correct, or write-solving strategies that are used in a coherent and right, or make a complete image and by the elements known and organized/arranged to facilitate the settlement of the problem.

Phase in solving the problem, students work on the settlement because to get the correct answer. Capability in solving the problem is characterized by the ability of students to work on the problems, according to the formulas that have been chosen, or by the completion strategy that has been chosen, or by an image that has been made.

Then the phase of confirmation of the process, the students perform checks on the process that has been implemented. Indicators of students already carry out confirmation of the process is characterized by the truth of the steps students to do because (the algorithm is correct). Not found any steps or procedures.

While the phase of confirmation of the answer is the final phase in which students need to confirm the answer to conform to those asked about the problem. Indicators of students already carry out confirmation of the answer is marked with the truth by the final answer what is asked in the problem.

This study used a research method with the qualitative approach, which has the natural characteristics as the data source directly, descriptive, more essential processes to obtain accurate results. The analysis in qualitative research tends conducted inductive analysis and meaning were the vital points in this study.

Research subject. The subjects were students in Advanced Calculus class. Selected only one class. The selected class was taken six students as research subjects. Selecting the subject of research based on the ranking value of students from researchers as lecturers. Two students were selected from the intelligent group, two students from the medium group, and two students from the lower group.

Technique Data Analysis and Interpretation. Analysis of the data in this study using the rules of Matthew B. Miles and A. Michael Huberman suggested that the activity in the qualitative data analysis performed interactively and lasts through to the end. Activities in the data analysis include data reduction, data display, data interpretation, and conclusion/verification.

3. Result and Discussion

3.1. General Results of Test

After lecturer gives the material of Dual Integral, then the students were given the problems solving test. Furthermore, after corrected by the lecturer, the initial findings is shown in Table 1.

Table 1. Type of Mathematical Connection and the Number of Students who failed in their solution

Type of Mathematical Connection	The number of students
Type 1	0
Type 2	0
Type 3	4
Type 4	3
The sum of students	7

Table 2. Failure of students based on the solution phase of the problem-solving test

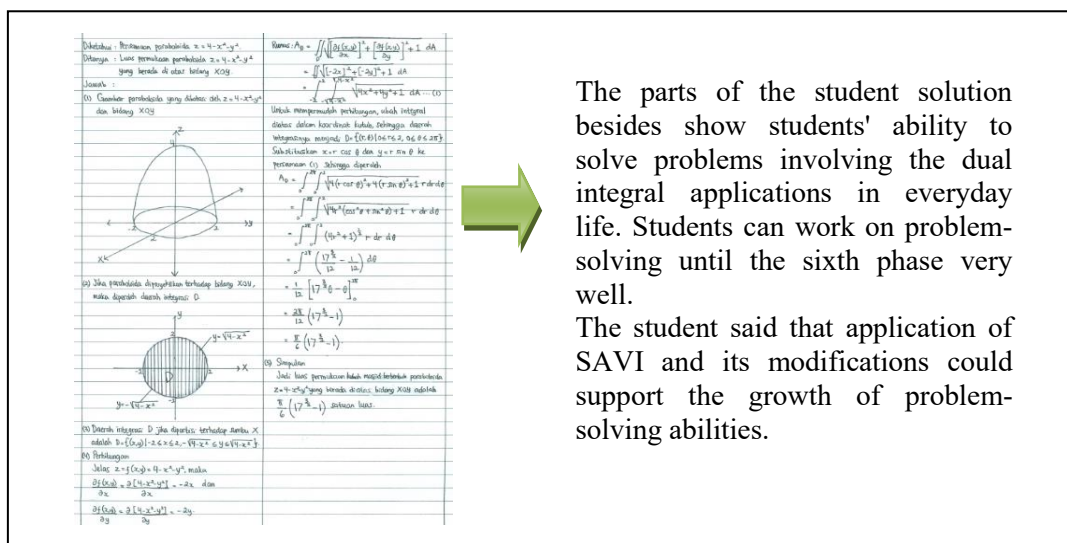
Phase of the problem-solving solution	The number of students
<i>Reading and understanding</i>	1
<i>Analyze and planning</i>	1
<i>Organizing strategy or organization on particular cases</i>	1
<i>Solving the problem</i>	32
<i>Confirmation of the process</i>	33
<i>Confirmation of the answer</i>	33

From the Table 2, it appears that the students had a failure in the process of solving the problem and the students also failed at confirmation of the process and confirmation of the answer.

3.2. The Ability Associated with Problem Solving Skills after the Implementation of SAVI

Here was described one example of the problem-solving solution based on test results, interviews, and triangulation. The student from the intelligent group showed in Figure 1.

As discussion, some students were still experiencing difficulties in solving the problems associated with the ability of mathematical connections involving other subjects. The application of learning model SAVI and its modifications effective in supporting the growth of problem-solving abilities of the students. The ability of the students related to solving the problem, there were two students in the excellent category, there were three students in good categories and one student in the medium category. According to all the students as the research subjects, application of SAVI and its modifications can support the growth of problem-solving abilities.



The parts of the student solution besides show students' ability to solve problems involving the dual integral applications in everyday life. Students can work on problem-solving until the sixth phase very well.

The student said that application of SAVI and its modifications could support the growth of problem-solving abilities.

Figure 1. The Student From The Intelligent Group

4. Conclusion

The conclusions of this research were as follows. The description of the problem-solving skills of mathematics education students of UNNES post-implementation SAVI and its modifications. The results were: (1) We can make a sample/model of the subject matter of the Dual Integral containing mathematical connection that fosters student problem-solving ability. (2) SAVI and its modifications on the topic of Dual Integral can be promoting problem-solving abilities of students of Mathematics Education, UNNES. (3) Had obtained the results on problem-solving ability of students of Mathematics Education, UNNES - Semarang on the subject of post-implementation SAVI and its modifications on Dual Integral.

The advice given was as follows: (1) Lecturers need to provide a variety of problems, so that the effectiveness of the application of learning models SAVI and its modifications increases, (2) Lecturers need to train students to work on the problems that have requirements as a matter capable of being used as a tool to uncover the ability of student in problem-solving.

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