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Analysis and Tracing of the Problem Solving Process by Students in Advanced Calculus at UNNES

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***Abstract* - There are five basic mathematical skills that must be mastered by students, namely the ability of problem solving, the ability of reasoning and evidence, the ability of mathematical communication, the mathematical connection ability, and the ability of representation. Researcher focus on the area of Problem Solving. This study objective to obtain the results of the analysis through tracing the Problem Solving Process by students of Mathematics Education in Advanced Calculus at UNNES. The research method uses a qualitative approach. The research subjects were chosen by 6 students who took the Advanced Calculus lecture. Data analysis includes data reduction, data exposure, data interpretation, and conclusion. The data source is taken from the results of tests, interviews, and triangulation. The results: (1) Some students still experience difficulties in the process of solving problems. (2) The abilities of students were related to the problem solving process, there were two students who were categorized Very Good, there were three students categorized as Good, and one student is in the Medium category. In conclusion: (1) There were still students who had difficulty in solving problems related to Advanced Calculus. (2) The Problem Solving Process for students was not categorized as Less or Very Less.**

Keywords: Problem Solving Process, Advanced Calculus

I. INTRODUCTION

A. Backgorund

Problem solving is one of the five basic mathematical abilities that students must master (Satchakett & Sitthipon, 2014) and (Yu et al, 2015). The five basic mathematical abilities are problem solving ability, reasoning and evidence ability, mathematical communication ability, mathematical connection ability, and representation ability, (Aydoğdu & Keşan, 2014) and (Sugiharti & Suyitno, 2015). Students of Mathematics Education as teachers candidate, need to master these 5 basic abilities. There is a gap between facts and academic demands. Academic demands, students must master the five basic abilities. In fact, the five basic abilities have not been specifically taught. In this study, due to time, cost, and extent of the problem, breeding material is only limited to the topic of Dual Integral. Dual Integral is a topic in Advanced Calculus.

B. Solutions

The solution, lecturer needs to provide provisions on how students have adequate knowledge about the five basic abilities, (Widyaningrum et al, 2016) and (Diaz et al, 2017). Through this dissertation research, researcher wants to uncover basic skills on the problem solving side. Student ability of the problems solving process are explored through Advanced Calculus lectures.

C. Research Objectives and Benefits

The objective is to obtain the results of the analysis through the search for Problem Solving Processes by students of Mathematics Education in Advanced Calculus at UNNES. Expected benefits: (1) students know and master one of the basic abilities in learning mathematics, namely problem solving; (2) students are expected to be encouraged to get to know, know, and master the other four basic abilities, (Huda et al, 2017) and (Gravemeijer et al, 2017).

D. Problem Solving Process

Quite a lot of mathematicians who pursue the field of this problem solving ability. For example Polya, Krulick & Rudnick, Zalina, Tambychik & Thamby, Cañadas, and others, (Pujiastuti et al, 2018). According to Atteh et al (2017) and Manah et al (2017), the mathematical problems solving can only be used as a means to improve problem solving abilities for students if: (1) the prerequisite material to find solutions to a given problem has been discussed, (2) solutions to problems affordable by students, (3) Solution algorithm has not been explained by the lecturer, and (4) there is a desire of students to solve their problems. So, not all

problems can be used as a tool to improve problem solving abilities.

There are five basic types of abilities in mathematics that can be learned. For a long time, the problem solving process was the focus of mathematics learning. However, there seems to be no real effort from lecturers to improve their students' problem solving processes. Caesar et al (2016) wrote that the problem solving process is a process that requires a high level of cognitive ability. Then, Abdullah et al (2015) stated that high-level cognitive is needed to improve students' problem solving processes. According to Evans (2012) and Hija et al (2016) there were two important problems in developing the ability to solve mathematical problems, namely problems finding and proving the problems.

Based on the opinions of the experts, researcher have tried, choose, and set up of six steps of the processes to resolve the mathematical problem solving, namely:

(1) reading and understanding;
(2) analysing and planning;
(3) organizing strategy;
(4) Solving the problem;
(5) confirmation of the process;
(6) confirmation of the answer.

- Step in reading and understanding, student reads it until they understand. The ability to read and understand is marked by the ability of students to write what is known and what is asked correctly, according to the problem.
- Step in analyzing and planning, student begins to analyses the results of thought and then begin to plan their completion strategies, including perhaps designing its drawings.
- Step in organizing strategy, student begins to arrange in sequence, with the strategies chosen. Student can write and sort formulas that will be used logically and correctly.
- Steps in solving problems, student works on completion to get the right answer according to the completion strategy they have chosen.
- Step in confirmation of the process, the student perform checks on the process that has been implemented.
- Step in confirmation of the answer, students need to confirm the answer to conform to those asked in the problem.

II. METHODS

This research uses a research method with a qualitative approach. Analysis in qualitative research tends to be done by inductive analysis to obtain valid results.

a. **Research subject.**

The subjects were students in Advanced Calculus class. Selected only one class. Selected class was taken 6 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.

b. Data Analysis and Interpretation.

Analysis of the data in this study using the rules of (Miles & Huberman, 2014) and Mayring (2014). 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.

III. RESULTS AND DISCUSSION

a. **Initial Results of Test.**

In order to obtain complete data, the lecturer provides tests related to the Dual Integral. There are 4 problems, namely problems related to the formulas that are being explained (type1), related to formulas that have been explained (type 2), related to other courses (type 3), and related to daily life (type 4). Initial results were as follows.

Table 1.
Type of Mathematical Connection and the Number of Students who were fail 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
Reading and understanding	1
Analyze and planning	32
Organizing strategy	1
Solving the problem	3
Confirmation of the process	1
Confirmation of the answer	1

b. **The Ability Associated with Problem Solving Process**

The main results of this study are as follows. (1) Some students still experience difficulties in the process of solving problems. (2) The ability of students related to the problem solving process,

there are two students who are categorized Very Good, there are three students categorized as Good, and one student is in the Medium category. (3) Based on the analysis and tracing of the Problem Solving Process by students in Advanced Calculus, the researcher found that the steps in the processes to resolve the mathematical problem solving, there were 5 steps, namely: reading and understanding, organizing strategy, solving the problem, confirmation of the process, and confirmation of the answer. Step 2, namely Analyze and Planning is not done by students. Students assume that step 2 is the same as step 3. Step 2, namely Analyze and Planning is not done by students. Students assume that step 2 is the same as step 3.

Here was described one example of the problem solving solution process based on test results, interviews, and triangulation. One student from the intelligent group:

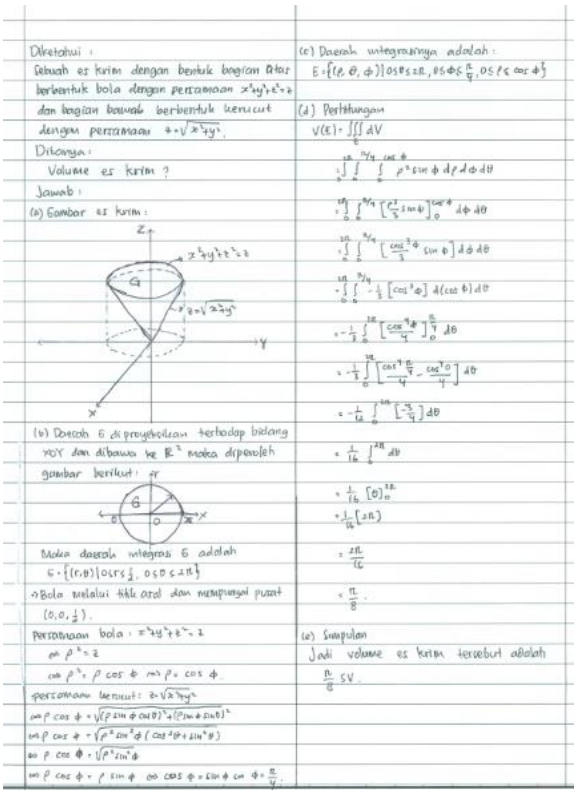

Figure 1. Problem Solving

The figure above shows the problem solving process which involves the application of Dual Integral in everyday life (type 4). Students can work on the problem solving process through 5 steps very well and clearly. This student's work can show the growth of the problem solving process which only covers 5 steps, namely: reading and understanding, organizing strategy, solving the problem, confirmation of the process, and confirmation of the answer. Students think that step 2 was the same as step 3.

IV. CONCLUSIONS

The conclusions of this research were as follows. The description of the problem-solving process of mathematics education students of UNNES post implementation of lecturing of Dual Integral and test. (1) There were still students who had difficulty in solving problems related to Advanced Calculus. (2) The Problem Solving Process for students was not categorized as Less or Very Less.

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