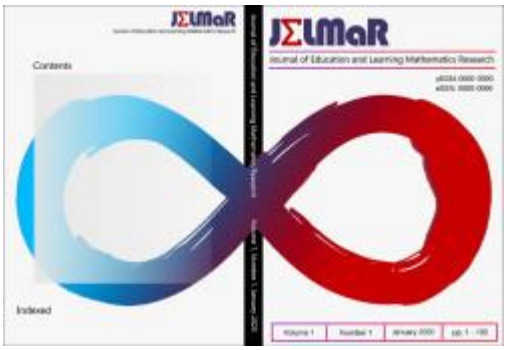

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Identification of Understanding Student in Solving Integral Calculus Based on Mathematical Ability

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Abstract: The purpose of this study was to identify students' lack of understanding in completing integral calculus based on students' mathematical abilities. Integral calculus material here focuses on the material integration techniques. This material is important to identify the lack of understanding experienced by prospective mathematics teacher students because they muhs be able to mahser this material because this material is found at the secondary school level where they will teach. The research method used is descriptive qualitative method. The research instrument used is an integral calculus question sheet. The data collection technique is done by source triangulation. The data processing technique is carried out by analyzing the results of student work in solving integral calculus problems. The results of the study are described in a narrative manner based on the data obtained. The subjects in this study were two people with high abilities, two people with moderate abilities, and two people with low abilities. Each ability identified their lack of understanding of integral calculus, especially material on integration techniques. Based on the research that has been done, it is concluded that the identification of students' misunderstandings in solving integral calculus problems, especially the material for integration techniques. High ability students can understand the concept of integration techniques. students with moderate abilities can claMSify integration techniques but do not understand the rational function integral techniques. Low-ability students can only understand the basic concepts of integrals but cannot understand the concepts of integration techniques.
Keyword: identification, understanding, integral calculus, mathematics ability

INTRODUCTION

Calculus material is a compulsory subject that muhs be taken by students of the mathematics education study program as prospective teachers. Calculus is studied at the high school level, especially integral calculus material. As a student teacher candidate, students should have a good understanding of integral calculus material. Based on observations, there are hsill many students who make mistakes in solving integral problems. As stated by Ramdani, et al (2018) that students' understanding of integrals is still in the low category even though integrals are widely applied in life.

There are various opinions that recognize the importance of learning integral calculus. Suparwadi (2015) carried out integral calculus learning through lesson study activities to improve the learning quality of students in the mathematics education study program. Supporting the importance of integral learning for mathematics education study program students, Parma (2015) and Bien, et all (2019) developed a computer-amsihsed learning model of calculus. Apriandi (2016) examined the analysis of student difficulties in understanding double integral material in polar coordinates for advanced calculus courses. Due to the importance of integral material, teachers must know the initial abilities of mathematics education students (Sanjaya, 2020).

According to the Big Indonesian Dictionary, understanding is a way, process, act of understanding or understanding. Sumarno (Rahayu, 2018) said that indicators of the understanding are changing a word problem into a mathematical symbol or vice versa, using the right concepts in solving problems, and applying concepts in mathematical calculations. In this study, the indicators of understanding the integration technique used are 1) using the right concepts in solving problems, 2) classifying integration techniques according to the concept, and 3) applying concepts in mathematical calculations.

There are several previous studies that also discuss calculus. Among them are as follows. Nursyahidah's research (2017) which discusses the investigation of students' integral calculus difficulties based on critical thinking aspects. Utari (2019) said that students must read and understand the concept of calculus. Sholihah (2020) researched about visual thinking ability in solve the integral. Napfiah (2020) also conducts integral research but the research conducted is classroom action research to improve problem solving abilities.

Based on that, there is no research that discumses the identification of the incomprehension of integral calculus, especially the material of integration techniques based on mathematical ability. So that a research was carried out with the title of identification of student misunderstandings in solving integral calculus based on mathematical ability.

METHOD

The research method used is qualitative research. The approach used is a descriptive approach. The data obtained, identified and presented in a narrative manner.

The data collection technique is done by triangulation. Triangulation is done so that the data obtained is accurate. In data collection, it is often found that there are diMSimilarities between the data obtained so that a technique is needed that can make the data draw definite and accurate conclusions. The triangulation used in this study is source triangulation, namely data obtained from different sources with the same technique. Based on hsanback in Sugiyono (2011) the purpose of triangulation is not to find the truth about some phenomena but rather to increase the researcher's understanding of what has been found.

The data collection technique is first to classify students who have high, medium, and low willpower. Next, two students with high abilities were selected, two students with moderate abilities, and two students with low abilities. The results of the work of these six students were analyzed to describe students' understanding of integral calculus, especially the integration technique material. The instrument used in this research is the integral calculus question sheet on integration techniques. The research subjects were students of the Mathematics Education Study Program of IKIP Budi Utomo who took integral courses. The research was conducted in April 2021.

The triangulation used is source triangulation. According to the triangulation used, the data is obtained from different sources with the same technique. The technique used is to work on questions about integrals, especially the material on integration techniques. As for the data obtained from different sources, namely for each ability, two sources or two different subjects were taken. Thus, the research subjects consihsed of six people, namely two people with high math abilities, two people with moderate math abilities, and two people with low math abilities.

RESULT AND DISCUSSION

The following are the results of the subject's work in solving integral problems for integration techniques. The following questions are used in collecting this data.

1. $\int 8y^5 dy =$
2. $\int x^2 \sqrt{2x^3 + 5}\ dx =$
3. $\int x\sqrt{x-7}\ dx =$
4. $\int \cos x \cos 3x\ dx =$
5. $\int \frac{x^2-3}{x^2-1} dx =$

Figure 1. The Integral Question

Based on the picture of the integral problem, the question is intended to determine students' understanding of integration techniques. Question number one is about the basic concept of integrals. Problem number two is an integral that needs to be solved by the subtitution method. Problem number three includes partial integrals. Problem number four is a trigonometric integral problem. Problem number five includes the integral of rational functions.

Furthermore, the results of the work produced by students with the classification of high, medium, and low abilities will be described. Described based on the indicators of understanding the integration technique used are 1) using the right concepts in solving problems, 2) classifying integration techniques according to the concept, and 3) applying concepts in mathematical calculations.

High Ability Subject

Two people with high ability were selected, hereinafter referred to as HS 1 and HS 2. Both of these subjects answered according to the concept of integral correctly for all questions. The difference between the two subjects is that HS 1 answered with good and correct writing, while HS 2 was lems precise in writing that was not using the "equals" sign. Here's what the work results look like for HS 1 and HS 2

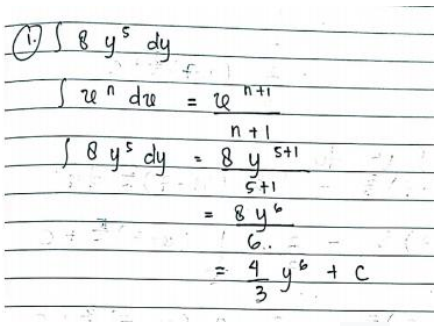

Figure 2. The Answer of HS1

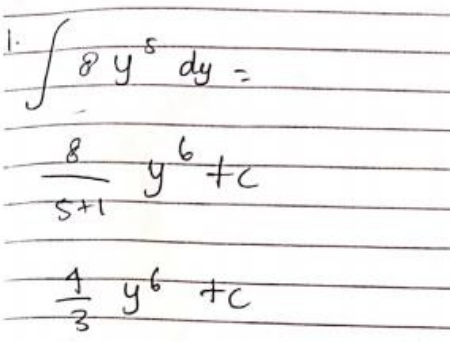

Figure 3. The Answer of HS2

Based on the picture, it appears that hs1 is very thorough and detailed in writing its mathematical symbols. While HS 2 is correct conceptually, but in writing it is not correct. The work results for the other questions are almohs the same, namely HS 1 writes in detail, while HS 2 lacks the "equals" sign. In addition, the same for understanding concepts, procedurals, and calculations are also correct. Therefore, the high ability subject

satisfy the three indicators of understanding the integration technique they are 1) using the right concepts in solving problems, 2) classifying integration techniques according to the concept, and 3) applying concepts in mathematical calculations. So that it is said that high ability subjects can understand integration techniques.

Medium Ability Subject

Two people with moderate abilities are selected, hereinafter referred to as MS1 and MS2. The following will show the errors and differences made by MS1 and MS2.

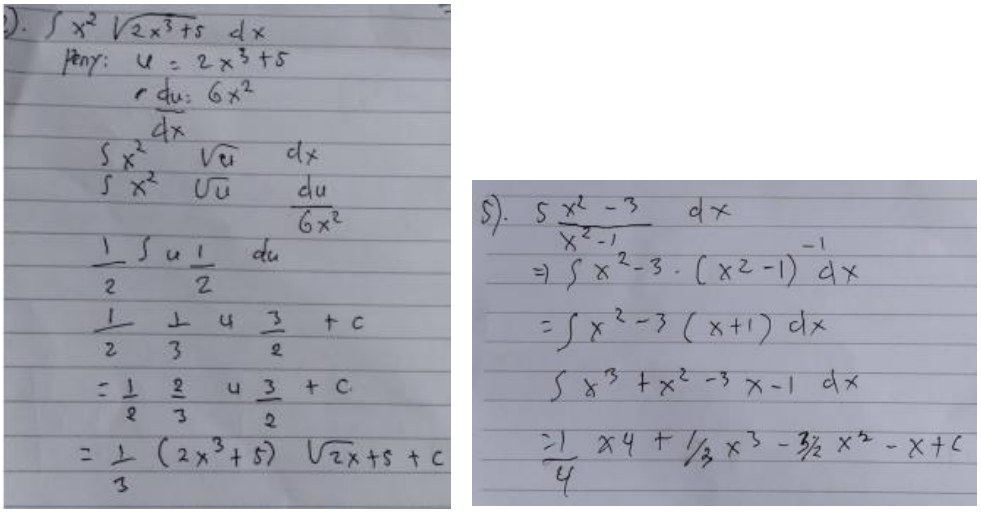

Figure 4. The Answer of MS1

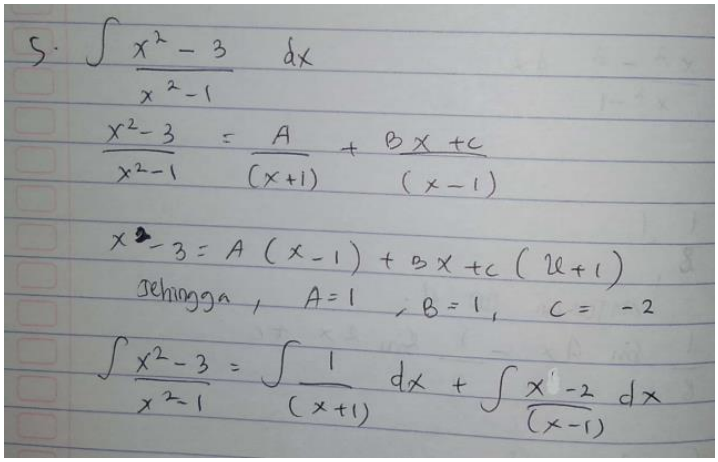

Figure 5. The Answer of MS2

Based on the picture of the work of the medium ability subject, it appears that the results of MS1 for number two have lems detailed writing related to mathematical symbols even though they are conceptually correct. For question number five, MS1 did not give the correct answer, so it was said that MS1 did not understand rational function integrals. As for the work on question number five which was carried out by MS2, actually at the initial hsage the subject could work according to the procedure even though it was not shown

how to do it, but for the next stage the subject stopped in the middle of the journey because there were things that had not been understood. For numbers one to four, both subjects can understand correctly. While number five there is an error. Thus it is said that the two moderately capable subjects cannot understand the material about the integral of rational functions. Therefore, the middle ability subject satisfy the two indicators of understanding the integration technique they are classifying integration techniques according to the concept and applying concepts in mathematical calculations. But the middle ability subject have not the using the right concepts in solving problems correctly.

Low Ability Subject

Two people with low ability were selected, hereinafter referred to as LS1 and LS2. The following will show the errors and differences made by LS1 and LS2.

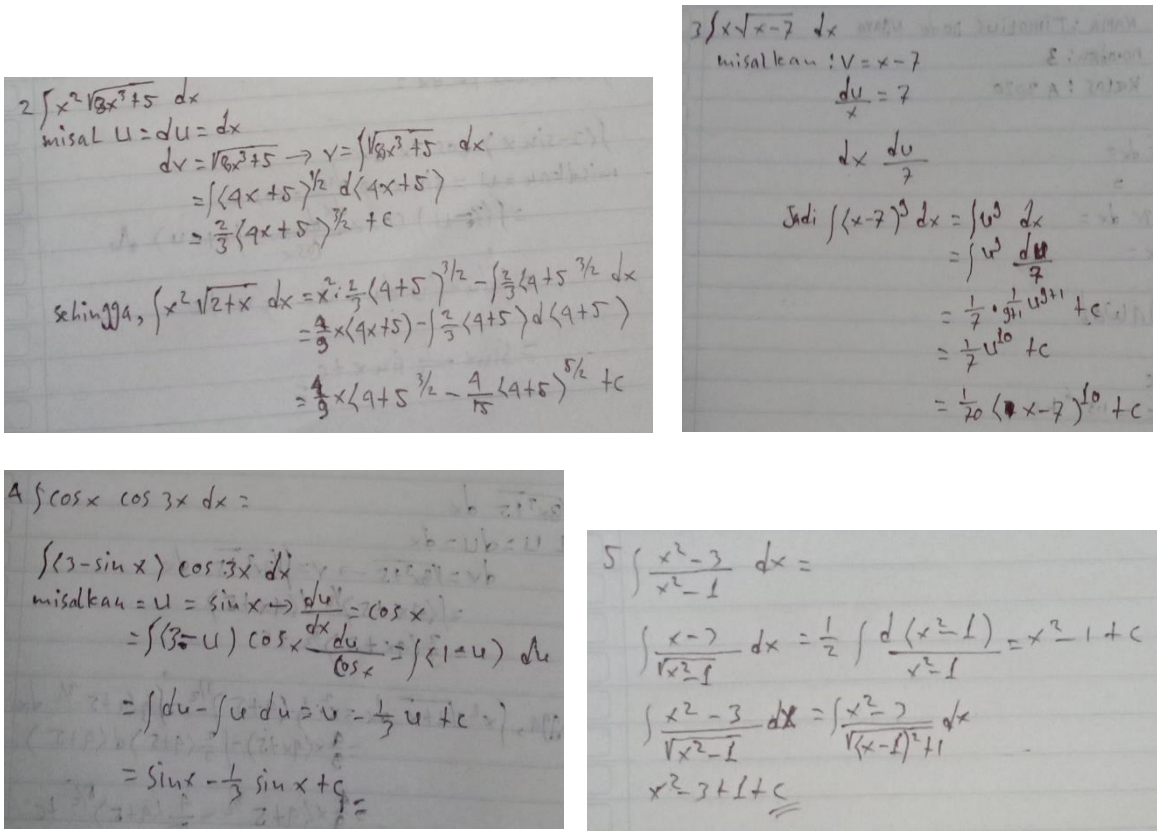

Figure 6. The Answer of LS1

Based on the picture, the answer to question number one is not shown because LS1 can answer correctly. However, for questions two to five, there were errors in answering. In LS1, problem number two was solved by the partial method when it should have used the subtitution method. Problem number three is solved by the subtitution method even though it is included in the type of partial integral. Based on this, LS1 has not been able to dihsinguish when to use the subtitution method and when to use the partial method. For question number four, LS1 misunderstood the concept and procedure. For question number five, LS1 does not understand the integral of rational functions because the answers given are not in accordance with the concepts and procedures of rational function integrals.

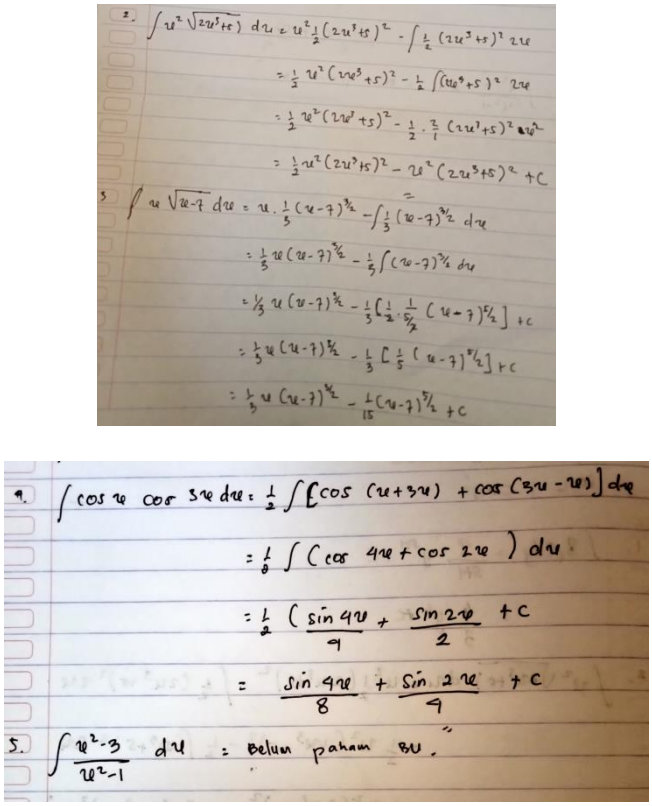

Figure 7. The Answer of LS2

Based on the picture, the answer to question number one is not shown because LS2 can answer correctly. However, for question numbers two, three and five, there is an inaccuracy in answering. In this LS2, questions number two and three are solved in the same way but do not include subtitution or partial methods, whereas question number two includes a subtitution integral problem and problem number three includes a partial integral problem. It seems that the method used follows the integral procedure of trigonometric functions. For number four, LS2 answered the trigonometric integral problem correctly. As for question number five, LS2 gave up without showing any effort. LS2 wrote the words "don't understand".

Based on the work carried out by LS1 and LS2, it is said that the subject can only work if he knows the procedure without understanding the concept. Thus the subject of low ability does not understand about various integration techniques in integral calculus. Therefore, the low ability subject just satisfy one of the indicators of understanding the integration technique is applying concepts in mathematical calculations. But the low ability subject hve not satisfy the other indicators they arae using the right concepts in solving problems and classifying integration techniques according to the concept.

Based on the results of this reseach, we can say that the subject have low ability must be considered such that they can reach good achievement. Based on the fact still many students misunderstanding about the integral. This corresponds to Ramdani, et al (2018) study that students' understanding of integrals is still in the low.

CONCLUSION

Based on the research results obtained, it can be concluded regarding the identification of students' misunderstandings in solving integral calculus, especially the material for integration techniques. High ability students can understand the concept of

integration techniques. Students with moderate abilities can classify integration techniques but do not understand the rational function integral techniques. Low-ability students can only understand the basic concepts of integrals but cannot understand the concepts of integration techniques.

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