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RESEARCH ARTICLE

Difficulties of Undergraduate Students to Understand of 2ndCalculus

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ARTICLE HISTORY

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KEYWORDS

Students' Difficulties;
Types and the Factors;
Calculus;

ABSTRACT

This study aims to describe the types of difficulties and factors causing the undergraduate students of Mathematics Education to have difficulty to understand materials of 2nd Calculus. This research is descriptive research with quantitative and qualitative approach. The research instruments used were tests and interview guides. The data analysis techniques consisted of three stages, namely: data reduction, data presentation and conclusions. The results of his research are the types of difficulties faced by students of S1 Mathematics Education in understanding 2nd Calculus lecture material, namely: Difficulties in the stage of understanding, Difficulties in the transformation phase, Difficulties in the process skills stage, Difficulties at the stage of writing answers / solutions and the factors that caused by intellectual factors, namely: students do not understand the integral concept of substitution, Students do not understand the concept of trigonometric comparisons, students do not understand how to make an integral substitution example and do the substitution substitution into an integral form whose solution is to be sought, students do not understand about decomposition in trigonometry and do not understand which one decomposes and which one decreases, students do not know the formulas commonly used in trigonometry.

1. INTRODUCTION

2nd Calculus is a compulsory subject given in the Mathematics study program and Mathematics Education at a college. This course usually weighs 3 or 4 credits depending on the profile of graduates expected from a study program. 2nd Calculus courses consist of several main materials, namely: (1) Integration Technique, (2) Uncertain and Integral Unqualified Forms, (3) Infinite Series, (4) Cone Slices and Polar Coordinates, (5) Inner geometry Space and Vector, (6) Derivatives for Functions of Two or More Variables, (7) Integral Fold, (8) Vector Calculus.

In the Mathematics Education Study Program at the STKIP Muhammadiyah Enrekang, 2nd Calculus is a compulsory subject. This course is given to 3rd semester students in the hope that they can equip students in terms of analytical skills, think logically and systematically. With this capability, students are expected to be able to solve factual problems that will greatly support learning activities when the student becomes a teacher later.

In following 2nd calculus courses students are required to always have good learning readiness in addition to of course needing the power of reasoning and logic of high thinking. Therefore, most students assume that calculus II is a difficult course. This has an impact on student learning outcomes.

The lack of students' understanding of 2nd Calculus subject matter can also be found based on the student's low score. They must repeat this course in another semester to improve their grades. The response is almost the same at every exam and receiving the results sheet. For example, participants find it difficult to write the appropriate formula to solve the existing questions, need more assignments, need more discussion of the questions in the lecture (limited interview with one of the students who program the 2nd Calculus course conducted by the lecturer). This student response shows that students are still having difficulty in attending 2nd Calculus courses.

Looking at the above phenomenon about the many students who do not understand the 2nd Calculus course, the researcher intends to conduct research to analyze the problems faced by students so that they have difficulty understanding lecture material, namely material for 2nd Calculus subjects. The title of this study is "Difficulties of Undergraduate Students to Understand of 2nd Calculus".

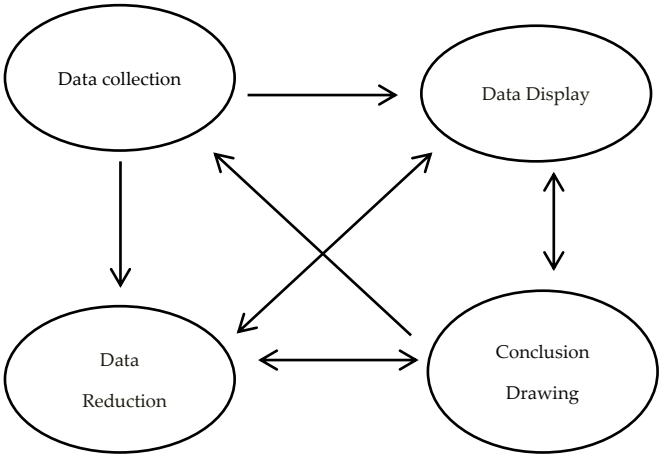
2. RESEARCH METHOD

This research includes descriptive research with quantitative and qualitative approaches. The quantitative approach is used to determine the number of errors faced by students by correcting the results of test answers related to 2nd calculus material. Test scores are used to select research subjects. While the qualitative approach is used to describe the types of difficulties and factors that cause difficulties by analyzing the results of tests and interviews with research subjects.

The research subjects in this research were students who obtained the lowest score from the test results given with a maximum value of 100, the lowest value of less than 45 was chosen

divided into three parts. The first part of the test results is in the interval 0-15, the second part of the test results is in the interval of 16-30 and the third part of the test results is in the interval 31-45. From each interval one student was taken as the research subject.

The instruments used in this study were Tests and Interviews. In this study data analysis follows the flow of qualitative data analysis activities according to Miles, Huberman and Saldana (2014, p. 14), that qualitative data analysis consists of three lines of activities that occur simultaneously, namely: data reduction, data presentation and conclusion drawing. The flow of qualitative data analysis activities according to Miles, Huberman and Saldana can be described as follows



3. RESULT AND DISCUSSION

3.1 Quantitative Data Analysis

From the results of the tests conducted on Friday, October 12, 2018 in the third semester students as many as 23 students, 21 students attended and there were not 2 people attending the Calculus II course hours, namely in the lesson 1-3 (08.00 - 10.30) with the following results:

No.	KODE NAMA MAHASISWA	NOMOR SOAL					TOTAL NILAI
		1	2	3	4	5	
1	Mahasiswa 1	0	15	0	0	0	15
2	Mahasiswa 2	2	2	0	2	2	8
3	Mahasiswa 3	2	0	0	2	2	6
4	Mahasiswa 4	1	15	0	1	1	18
5	Mahasiswa 5	20	10	0	1	2	33
6	Mahasiswa 6	0	17	0	0	0	17
7	Mahasiswa 7	2	2	0	2	2	8
8	Mahasiswa 8	0	2	0	2	2	6
9	Mahasiswa 9	2	2	0	0	2	6
10	Mahasiswa 10	5	2	0	20	2	29
11	Mahasiswa 11	17	20	0	15	2	54
12	Mahasiswa 12	20	15	0	15	2	52
13	Mahasiswa 13	1	17	0	0	0	18
14	Mahasiswa 14	17	20	0	15	2	54
15	Mahasiswa 15	0	20	0	10	2	32
16	Mahasiswa 16	2	2	0	0	2	6
17	Mahasiswa 17	20	20	0	20	2	62
18	Mahasiswa 18	0	10	0	0	2	12
19	Mahasiswa 19	2	2	0	0	2	6
20	Mahasiswa 20	2	20	0	0	2	24
21	Mahasiswa 21	2	17	0	1	2	22
NILAI MAKSIMAL							100

Figure 1. Student Test Results

Based on the results of the test and the selection criteria of the subject above, 3 students were chosen as research subjects as follows:

Table 1. Research subject

No.	Subject Name	Gender	Code
1	Student 9	Man	SP-1
2	Student 6	Women	SP-2
3	Student 15	Women	SP-3

While the schedule for conducting interviews with research subjects is as follows:

Table 2. Interview Schedule

No.	Subject Code	Date and time	Time	Place
1	SP-1	Friday, 19 October 2018	08.00-09.00	Lecture room
2	SP-2	Friday, 19 October 2018	09.00-10.00	Lecture room
3	SP-3	Friday, 19 October 2018	10.00-11.00	Lecture room

3.2 Qualitative data analysis

3.2.1 Difficulty Analysis of Research Subjects 1 (SP-1)

A. Integration with substitution

Answers given SP-1 at the time of the test based on the data on the answer sheet are as follows:

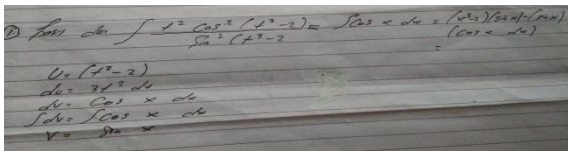


Figure 2. Test Results SP-1 For Number 1

From the results of the tests and the results of interviews, it was found that:

a. Types of subject difficulties in understanding integration material with substitution based on observations on the subject in solving questions about material integration with substitution, namely difficulties in the stage of understanding, difficulty in the process skill stage, difficulty in the transformation stage and difficulty in writing answers / solutions.
b. Factors that cause difficulties for the subject in understanding the integration material with substitution based on observations on the subject in solving questions about the material integration with substitution caused by intellectual factors, the subject does not understand the concept of substitution integral and partial integral, the subject does not understand the concept of trigonometric comparison. In addition, the subject does not understand how to make an integral substitution example and perform the substitution substitution into an integral form whose solution is to be sought.

B. Some integrals in trigonometry

Answers given SP-1 at the time of the test based on the data on the answer sheet are as follows:

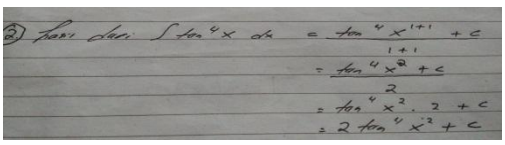


Figure 3. Test Results SP-1 For Number 2

From the results of the tests and the results of interviews, it was found that:

a. Types of subject difficulties in understanding some integral material in trigonometry based on observations of the subject in solving questions about some integral material in trigonometry, namely difficulties in the stage of process skills, difficulties in the transformation phase, difficulty in writing answers / solutions.
b. Factors causing difficulties for the subject in understanding some integral material in trigonometry based on the observation of the subject in solving questions about some integral material in trigonometry caused by intellectual factors namely the subject does not understand the concept of substitution integral and partial integral, the subject does not understand the decomposition in trigonometry and do not understand which ones describe and which ones decrease. In addition the subjects did not know the formulas commonly used in trigonometry and subjects did not know the operation used.

C. Partial integration

From the results of the tests and the results of interviews, it was found that:

a. Types of subject difficulties in understanding partial integration material based on observations of the subject in solving questions about partial integration material, namely difficulties in the stage of understanding, difficulty in the stage of process skills, difficulties in the transformation stage and difficulty in writing answers / solutions.
b. Factors causing difficulties in understanding the subject of partial integration based on observations of the subject in solving questions about partial integration material caused by intellectual factors, namely the subject does not understand the concept of derivatives so it is wrong in interpreting the meaning of the subject, the subject does not understand the concept of main partial integral in determining the formula partial integral

D. Integration of rational functions

From the results of the tests and the results of interviews, it was found that:

a. Types of subject difficulties in understanding rational function integration material based on observations of the subject in solving questions about rational function integration material, namely difficulties in the stage of understanding, difficulty in the transformation phase, difficulty in the process skill stage and difficulty in writing answers / solutions.
b. Factors causing difficulties in understanding the subject of rational function integration based on observations of the subject in solving questions about rational functional integration material caused by intellectual factors, namely subjects unable to distinguish between partial integrals and partial fractions, subjects do not understand the concept of changing an algebra into addition partial fractions.

3.2.2. Difficulty Analysis of Research Subjects 2 (SP-2)

A. Integration with substitution

From the results of the tests and the results of interviews, it was found that:

a. Types of subject difficulties in understanding integration material with substitution based on observations of the subject in solving questions about the material integration with substitution, namely difficulties in the stage of understanding, difficulties in the transformation phase, difficulties in the process skills stage, and difficulties in writing answers / solutions.
b. b) Factors that cause difficulties for the subject in understanding integration material with substitution based on observations of the subject in solving questions about material integration with substitution caused by intellectual factors, namely subjects do not understand the concept of integral substitution and partial integral, the subject does not understand the derivative concept of a function, The subject does not understand how to make an integral substitution example and performs the substitution into an integral form whose solution is to be sought.

B. Some integrals in trigonometry

Answers given SP-2 at the time of the test based on the data on the answer sheet are as follows:

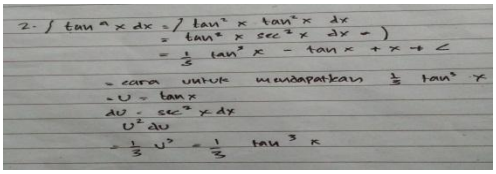


Figure 4. Test Results SP-2 For Number 2

From the results of the tests and the results of interviews, it was found that:

a. Types of subject difficulties in understanding some integral material in trigonometry based on observations of the subject in solving questions about some integral material in trigonometry, namely difficulties in the stages of process skills, difficulties in the transformation phase, difficulty in writing answers / solutions.
b. Factors causing difficulties for the subject in understanding some integral material in trigonometry based on the observation of the subject in solving questions about some integral material in trigonometry caused by intellectual factors, the subject did not know the formulas commonly used in trigonometry and subjects did not know the operation used.

C. Partial integration

From the results of the tests and the results of interviews, it was found that:

a. Types of subject difficulties in understanding partial integration material based on observations of the subject in solving questions about partial integration material, namely difficulties in the stage of understanding, difficulties in the transformation stage, difficulties in the process skills stage, difficulty in writing answers / solutions.
b. Factors causing difficulties in understanding the subject of partial integration based on observations of the subject in solving questions about partial integration material caused by intellectual factors, namely the subject does not understand the concept of derivatives so it is wrong in interpreting the meaning of the subject, the subject does not understand the concept of main partial integral in determining the formula partial integral.

D. Integration of rational functions

From the results of the tests and the results of interviews, it was found that:

a. Types of subject difficulties in understanding rational function integration material based on observations of the subject in solving questions about rational functional integration material,

namely difficulties in the stage of understanding, difficulty in the process skills stage, difficulty in the transformation stage and difficulty in writing answers / solutions.

b. Factors causing difficulties in understanding subject rational function integration based on observations of subjects in solving questions about rational function integration material caused by intellectual factors, namely subjects do not understand about partial fraction decomposition and subjects do not understand the concept of changing an algebra into a partial fraction addition.

3.2.3. Difficulty Analysis of Research Subjects 3 (SP-3)

A. Integration with substitution

From the results of the tests and the results of interviews, it was found that:

a. Types of subject difficulties in understanding integration material with substitution based on observations on the subject in solving questions about material integration with substitution, namely difficulties in the stage of understanding, difficulty in the process skill stage, difficulty in the transformation stage and difficulty in writing answers / solutions.

b. Factors that cause difficulties for the subject in understanding integration material with substitution based on observations of the subject in solving questions about material integration with substitution caused by intellectual factors, namely the subject does not understand the concept of integral substitution and partial integral. Besides that the subject did not understand the concept of derivative of a function, the subject did not understand the concept of trigonometric comparison, the subject did not understand how to make an example of the integral substitution and did the substitution into an integral form whose solution was to be sought.

B. Some integrals in trigonometry

Answers given SP-3 at the time of the test based on the data on the answer sheet are as follows:

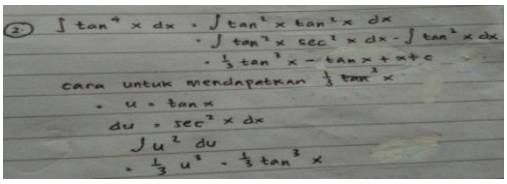


Figure 5. Test Results SP-3 For Number 2

From the results of the tests and the results of interviews, it was found that:

a. Types of subject difficulties in understanding some integral material in trigonometry based on observations of the subject in solving questions about some integral material in trigonometry, namely difficulties in the stage of process skills, difficulties in the transformation phase, difficulty in writing answers / solutions.

b. Factors causing difficulties for the subject in understanding some integral material in trigonometry based on the observation of the subject in solving questions about some integral material in trigonometry caused by intellectual factors, the subject did not know the formulas commonly used in trigonometry and the subject did not know the procedure for working on the problem integral substitution.

C. Partial integration

Answers given SP-3 at the time of the test based on the data on the answer sheet are as follows:

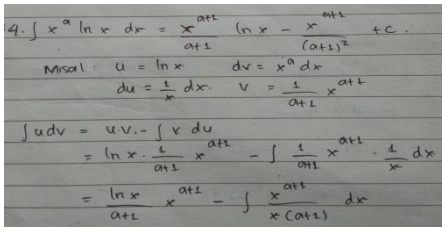


Figure 6. Test Results SP-3 For Number 3

From the results of the tests and the results of interviews, it was found that:

a. Types of subject difficulties in understanding partial integration material based on observations of the subject in solving questions about partial integration material, namely difficulties in the stage of understanding, difficulty in the stage of process skills, difficulties in the transformation stage and difficulty in writing answers / solutions.

b. Factors that cause difficulties in understanding the subject of partial integration based on observations of the subject in solving questions about partial integration material caused by intellectual factors, namely the subject does not understand the intent of the problem and the subject does not understand the concept of partial partial integral in determining the partial integral formula, from the formula is not can specify u and dv.

D. Integration of rational functions

Answers given SP-3 at the time of the test based on the data on the answer sheet are as follows:

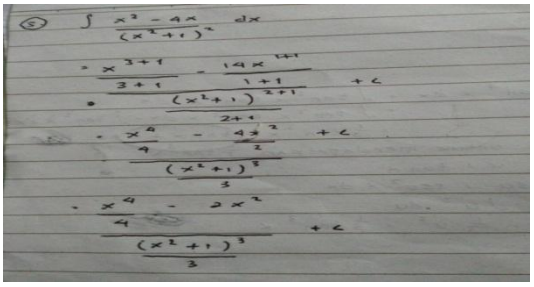


Figure 7. Test Results SP-3 For Number 4

From the results of the tests and the results of interviews, it was found that:

a. Types of subject difficulties in understanding rational function integration material based on observations of the subject in solving questions about rational functional integration material, namely difficulties in the stage of understanding, difficulty in the process skill stage and difficulty in writing the answers / solutions.

b. Factors causing difficulties in understanding subject rational function integration based on observations of subjects in solving questions about rational function integration material caused by intellectual factors, namely subjects do not understand about partial fraction decomposition and students do not understand the concept of changing an algebra into a partial fraction addition.

4. CONCLUSION

The types of difficulties faced by students of S1 Mathematics Education in understanding 2nd Calculus lecture material, namely:

a. Difficulties in the stage of understanding include students not knowing what is known from the problem, unable to distinguish between substitution integrals and partial integrals, students do not know which questions are done by using substitute integrals and which questions are worked with partial integrals. Students also do not understand what is ordered in the problem, students do not understand what is meant by the partial fraction decomposition method.
b. Difficulties in the transformation phase include students not knowing the formula used to solve questions about material integration techniques, one of which students do not know about trigonometric comparison formulas. Do not know the counting operation used to solve questions about integration techniques. Cannot make a model / picture of the information obtained from the question. Cannot change an algebraic form into a sum of partial fractions.
c. Difficulties in the process skills stage include students not knowing the steps used /done to work on questions about material integration techniques.

Difficulties at the stage of writing answers/solutions include students unable to find the final results of the questions about material integration techniques based on the procedures or steps that have been used. The factors that cause S1 Mathematics Education students have difficulty in understanding the lecture material of Calculus II caused by intellectual factors, namely:

1) Students do not understand the integral concept of substitution.
2) Students do not understand the concept of trigonometric comparisons
3) Students do not understand how to make an integral substitution example and do the substitution substitution into an integral form whose solution is to be sought.
4) Students do not understand about decomposition in trigonometry and do not understand which one decomposes and which one decreases.
5) Students do not know the formulas commonly used in trigonometry.
6) Students do not know the operation used in working on questions about integration techniques.
7) Students still do not know or understand how to change angles from degrees of formation π.
8) Students don't know to draw graphics and lines on the cartesius diagram.
9) Students do not know the formula for the volume of a rotating object.
10) Students do not understand the concept of derivatives.
11) Students do not understand the concept of the main partial integral in determining the partial integral formula.
12) Students cannot distinguish between partial integrals and partial fractions.
13) Students do not understand the concept of transforming an algebra into a sum of partial fractions.

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