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Profile of Metacognition of Mathematics Education Students in Understanding the Concept of Integral in Category Classifying and Summarizing

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This study describes the metacognition profile of female and male mathematics' education students in understanding the concept of integral calculus in the category of classifying and summarizing. This research method was an explorative method with the qualitative approach. The subjects of this study were mathematics education students at the University of Halu Oleo, totalling 47 students consisting of 12 male and 35 female. The process of selecting research subjects began with the provision of a mathematical ability test to 47 students taken from the question bank for the college entrance test. From the results of the test, selected 1 male and 1 female each have a high mathematical ability. The results of this study were as follows: There is no difference of metacognition profile between male and female mathematics education students in understanding the indefinite integral concepts in category classifying and summarizing. There was difference of metacognition profile between male and female mathematics education students in understanding the definite Integral concepts in category classifying and summarizing.

Keywords: metacognition, understanding, concept of integral, classifying, summarizing

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INTRODUCTION

Integral calculus is one of the compulsory courses programmed by mathematics education students. This course is a group of Scientific and Skills Subjects, aims to strengthen the mastery and expand the insight of the competence of expertise in working in the community in accordance with the competitive advantage and comparative study program implementation concerned.

The approach of learning lecturer's of integral calculus, generally using direct learning that is student-cantered learning. This approach expects student involvement to be active in classroom learning. The benefit that arises from a student-cantered pedagogic approach is the potential for increased conceptual understanding of the material learned by students (Tall, 2008). Furthermore, Park and Traves (1996), states that students can improve conceptual understanding without losing computing skills by learning mathematical principles through visual examples and summarizing rules for themselves. Then, Harden and Crosby (2000) describe teacher–centred learning strategies as the focus on the teacher transmitting knowledge, from the expert to the novice. In contrast, they describe student–centred learning as focus on the students' learning and "what students do to achieve this, rather than what the teacher does". This strategy is part of a student-cantered learning approach, where students are actively involved in learning while lecturers act as facilitators (O'Neill and McMahon, 2005).

With regard to the understanding of mathematical concepts, a question arises that does the learning mechanism of new concepts be sufficient to memorize and remember? Science and mathematics educators are increasingly recognizing that an understanding of conceptual change is as important as analysing self-concept. In fact, most of the results of research have determined that the concept of mental structure related to intellectual, not only related to the subject matter. The results of Bartsch's research (1998) show that mental structures related to intellectuals can form mental concepts that govern human experience and memory (Ben-Hur, 2004). Therefore, conceptual changes represent structural cognitive changes, not simply additive changes. Based on research in cognitive psychology, the attention of research in education has shifted from content (eg, mathematical concepts) to predicate mental, language, and pre-concepts (Ben-Hur, 2004). Despite this research, many lecturers continually bring new concepts to students as if they were merely providing knowledge by memorizing and recalling. This practice may be one of the causes of misunderstanding in mathematics learning.

The results of the above research are in line with the results of Utu Rahim & La Misu (2015), that generally students of Mathematics Education Department in the first semester have not been able to distinguish between facts, concepts, principles, and skills. This fact can be traced from the results of student answers when solving the integral problem that most students only memorize the formula or integrating techniques. Rarely does a student solve an integral problem based on an integral concept. Students struggle to put forward the initial idea of settlement. Sometimes the initial idea is already available but the students are confused to continue the next step. Sometimes students can also completely integrate, but they have not been able to reveal the reasons for each step.

Based on the facts above this research has linked metacognition with an understanding of the concept of integral calculus in mathematics education students. The goal is that in the learning process the integral calculus of the students is trained to always give every step in understanding the concept of integral. Thus, students are always consciously using their thinking in giving formal reasons for all integral problems.

The concept of understanding studied in this paper uses Bloom's theory developed by Anderson *et al.* (2001) and Mayer (2002). There are 7 categories to understand the concept of integrals based on the theory, namely: Interpreting, Exemplifying, Classifying, Summarizing, Inferring, and Explaining. Understanding the concept of integral categories of interpreting and exemplifying to Mathematics students has been studied by La Misu (2017), the result was a different metacognition profile between male and female students in understanding the concept of integral in the category of interpreting, especially the concept of definite integral. This paper discusses the metacognition profile of mathematics education students in understanding integral concepts in classifying and summarizing categories. The classifying category is defined as determining that something belongs to a category. While of the summarizing category is defined as abstracting a general theme or major point (s) (Mayer, 2002).

The metacognition profile in comprehending the integral concept is reviewed in two categories: cognitive knowledge consists of declarative knowledge, procedural knowledge, and conditional knowledge (Flavell, 1979), and metacognition skills comprising planning, monitoring and evaluating (Dawson, 2008, Curriculum (PPK) Malaysia, 2001 and Livingston, 1997). The details of metacognition components can be seen in Table 1.

Table 1
Metacognition Component

Component	Sub- Component	Indicator
1. Metacognitive knowledge	Declarative knowledge	Factual information (based on actual facts) that one understands and can be mentioned or written
	Procedural knowledge	How to do something, and how to do the steps in a process
	Conditional knowledge	How to use a procedure, skill, or strategy, and how it is not used
2. Metacognitive skill	Planning	1. Suspect what will be learned, how the concept is mastered, and the impression of the concept learned 2. Make a plan how to understand a concept well.
	Monitoring	1. Is this concept I can learn?. 2. How this concept can be explained?.
	Evaluating	1. How this concept I mastered?. 2. Why I am easy / difficult to master it? 3. What action to take?

The metacognition profiles of students in this study were differentiated between male and female students. Thus, the questions of this study are: (1) how are profiles of metacognition of male mathematics education students in understanding the concept of integral calculus in categories of classifying and summarizing? and (2) how are profiles of metacognition of female mathematics education students in understanding the concept of integral calculus in categories of classifying and summarizing?

METHOD

Research Design

This type of research was explorative with qualitative approach. This explorative research was intended to explore metacognition of mathematics education students in understanding the concept of integral calculus so as to obtain the great profile of the student's metacognition. In order to recognize the characteristics of the qualitative approach of this study, the matters were presented following. First, the design of this research is natural. The data source was a mathematics education student who has studied the concept of integral calculus on regular lectures, no special treatment given prior to being interviewed. The key instrument on this study was the researcher, who acts as the interviewer. Second, the data collected from this research was information (collection of statements) provided by the source data in response to the stimulus provided by the researcher. Third, the research emphasizes "what is thought" and "why it is thought" by the data source rather than the product it produces. Fourth, this research does not build the hypothesis before the data collection, thus the data processing is not directed to test the hypothesis. Therefore, data processing tends to be inductive. Fifth, the data collected in this study was what the data source thinks about in concept, without any prior special treatment (Miles, Huberman & Saldana, 2014).

Research Subject

The selection of this research subject refers to the research question that was how the metacognition profile of male and female mathematics education students in understanding the concept of integral calculus in classifying and summarizing categories. The subjects of this study were mathematics education students at the University of Halu Oleo, totalling 47 students consisting of 12 male and 35 female. The process of selecting research subjects began with the provision of a mathematical ability test for 47 students taken from the question bank for the college entrance test. From the results of the test, selected 1 male and 1 female each have a high mathematical ability (minimum score of 70). The reason for taking students who have high mathematics skills because they want to get a research subject that does not experience cognitive conflict in understanding the concept of integral calculus, thus as to provide a complete picture/description of how to understand the concept. The criteria as follows: (1) Students taken from the Department of Mathematics Education is a student who passed the first selection of college entrance tests in the Department of Mathematics Education; (2) able to communicate their opinion/flow of thought verbally or in writing; and (3) selected subject of research has the highest achievement and mathematical ability.

Research Instruments

The main data of this research was obtained using interview technique. Interviews were used to explore more deeply about the metacognition profiles of male and female mathematics education students in understanding the concept of integral calculus with regard gender differences. The interview guide was based on an interview guide developed by Schraw & Dennison (1994). Interview methods were used semi-structured interviews based on tasks with the provisions of interview questions proposed tailored to the condition of students in understanding the concept of integral both in terms of answers and explanations of the answers given students. In addition, there are supporting data which is the result of the research subject task in understanding integral calculus task.

Data Analysis

The data analysis process follows the analysis model of Miles, Huberman & Saldana, (2014), consisting of (1) data reduction, data presentation, and (3) conclusion. Data reduction process is done by category or data classification. This activity is needed to sort out which data are needed to be analyzed in order to answer the research questions. Relevant and necessary data to answer such research questions, or assessed as "interesting" data/facts retained, and data unnecessary or irrelevant to the need to answer research questions "discarded "or removed. Presentation of research data is more dominant in the form of narration, although in summarizing all that has been narrated also used scheme (network). This scheme is intended to provide an easier picture of all data presented in the form of narration. Data presentation is done based on data categorization as stated previously. The conclusion is based on the result of data processing to answer the research question, which is finding the profile of metacognition of research subject in understanding the concept of integral calculus, both male and female students. At this stage also put forward results benchmarking against metacognition profiles of research subject in understanding the concept of integral calculus that has been obtained. Interpretation of data carried out simultaneously with data presentation activities. In this activity, researchers do the interpretation of research data (answers Research subject at the time of interview). Making conclusions and recommendations based on the results of data processing to answer research questions, namely finding the profile of students' metacognition in understanding the concept of integral calculus.

FINDINGS AND DISCUSSION

The results of this study reveal the metacognition profiles of male and female mathematics education students in understanding the concept of integral calculus, especially categories of classifying and summarizing. To reveal students' metacognition profiles, first, review of understanding of mathematics education students' of male and female on the concept of integral calculus based on students' answers in completing the task of understanding the concept of integrals. Secondly, through interviews, it can reveal the metacognition of students in understanding the concept of integral calculus.

Understanding of Male and Female Students on the Concept of Integral Calculus in the ***Classifying Category***

The answers of male and female students in understanding the concept of integral calculus in the classifying category can be seen in Table 2.

Table 2
The Answers of Male and Female Students in Understanding the Concept of Integral Calculus in the Classifying Category

Form of task	Answers of Students	
	Male	Female
a. Given some form of function, students are then asked to classify which groups have indefinite integrals, and which groups do not have an indefinite integral.	Functions that have an indefinite integral are: $f(x) = x^3+6$, $f(x) = 1/(x-2)^2$, $f(x) = \text{Cos}(x+3)$, $f(x) = \|x+2\|$, and $f(x) = \sqrt{5x+6}$ While the functions that do not have an indefinite integral are: $f(x) = e^{\sqrt{\ln x}}$, $f(x) = e^x/(\ln x)$, and $f(x) = e^{\sin x}$.	Functions that have an indefinite integral are: $f(x) = x^3+6$, $f(x) = 1/(x-2)^2$, $f(x) = \text{Cos}(x+3)$, $f(x) = \|x+2\|$, and $f(x) = \sqrt{5x+6}$ While the functions that do not have an indefinite integral are: $f(x) = e^{\sqrt{\ln x}}$, $f(x) = e^x/(\ln x)$, and $f(x) = e^{\sin x}$
b. Given some form of function, then the student is asked to classify at which interval has a definite integral, and which intervals do not have a definite integral.	1). $f(x) = \sqrt{x-1}$ In the interval [1, ~) it has a definite integral, and the hose (- ~, 1) does not have a definite integral. 3) $f(x) = \frac{1}{(x+1)^3}$ In the interval R - {-1} has a definite integral, and the point x = -1 has no definite integral 5) $f(x) = \sin(x+3)$, In the $x \in R$ interval, it has a definite integral. 6) $f(x) = \|x+5\|$, In the $x \in R$ interval, it has a definite integral. 7) $f(x) = [\|x\|] +3$, In the $x \in R$ interval, it has a definite integral.	Functions that have a definite integral are: $f(x) = \sqrt{x-1}$, $f(x) = \sqrt{x+3}$, $f(x) = \frac{1}{(x+1)^3}$, $f(x) = \frac{1}{(x-2)^2}$, $f(x) = \sin(x+3)$, and $f(x) = \frac{x^2+4}{\sqrt{x^3}}$ Functions that have no a definite integral are: $f(x) = \|x + 5\|$ and $f(x) = [\|x\|] +3$

Based on the results of the answers students in Table 2, the male and female students can classify some functions that have indefinite integrals and some functions that do not have an indefinite integral. In addition, male students can determine a function at an interval to have or not have a definite integral. While female students cannot determine a function at an interval has or does not have a definite integral.

*Results of **Male Student** Interviews about Understanding the Concept of Integral Calculus on the Classifying Category*

Results of male student interviews about understanding the concept of integral calculus on the category of classifying consists of the concept of indefinite integrals and definite integrals:

Results of Male Student Interviews ***the Indefinite Integral Concept*** *on the Classifying Category*

The results of male student interviews in understanding the concept of indefinite integrals in the classifying category as follows:

(1) *Declarative knowledge*: The male students can classify groups of functions that have indefinite integrals: $f(x) = x^3+6$, $f(x) = 1/(x-2)^2$, $f(x) = \text{Cos}(x+3)$, $f(x) = |x+2|$, $f(x) = \sqrt{5x+6}$, and does not have an indefinite integrals: $f(x) = e^{\sqrt{\ln x}}$, $f(x) = e^x/(\ln x)$, $f(x) = e^{\sin x}$;

(2) *Procedural knowledge*: The male students can only give reasons for simple functions of either having or without indefinite integrals such as polynomial functions, rational functions, trigonometric functions, absolute value functions and irrational functions;

(3) *Conditional knowledge*: The male students can use the procedure to show that a function group has or does not have an indefinite integral but only a simple function;

(4) *Planning*: The male students can determine the hook elements a group of functions has or does not have an indefinite integral;

(5) *Monitoring*: The male students can explain a group of functions that have or do not have an indefinite integral but only a simple function; and

(6) *Evaluating*: The male students can assert that a group of functions has or does not have an indefinite integral is true but only a simple function.

Based on the interview result of this male students, then the male students have used metacognition knowledge and metacognition skills in understanding the concept of indefinite integrals in the classification category, but only on the simple function.

Results of Male Student Interviews ***the Definite Integral Concept*** *on the Classifying Category*

The results of male student interviews in understanding the concept of definite integrals in the classifying category as follows:

(1) *Declarative knowledge*: The male students can classify intervals of functions that have or do not have a definite integral;

(2) *Procedural knowledge*: The male students can give a reason that at certain intervals the functions have or do not have a definite integral;

(3) *Conditional knowledge*: The male students can use the procedure to show that at an interval of certain functions have or have no a definite integral;

(4) *Planning*: The male students can determine the corresponding elements of an interval on certain functions having or not having a definite integral,

(5) *Monitoring*: The male students can explain easily from an interval on certain functions having or not having a definite integral; and

(6) *Evaluating*: The male students can affirm that at an interval of certain functions having or not having a definite integrals is true.

Based on the interview result of this male students, then the male students have used metacognition knowledge and metacognition skills in understanding the concept of definite integrals, in the category of classification.

*Results of **Female Student** Interviews about Understanding the Concept of Integral Calculus on the Classifying Category*

Results of female student interviews about understanding the concept of integral calculus on the category of classifying consists of the concept of indefinite integrals and definite integrals:

*Results of Female Student Interviews **the Indefinite Integral Concept** on the Classifying Category*

The results of female student interviews in understanding the concept of indefinite integrals in the classifying category as follows:

(1) *Declarative knowledge*: The female students can classify groups of functions that have indefinite integrals: $f(x) = x^3+6$, $f(x) = 1/(x-2)^2$, $f(x) = \mathrm{Cos}(x+3)$, $f(x) = |x+2|$, $f(x) = \sqrt{5x+6}$, and does not have an indefinite integrals: $f(x) = e^{\sqrt{\ln x}}$, $f(x) = e^x/(\ln x)$, $f(x) = e^{\sin x}$;

(2) *Procedural knowledge*: The female students can only give reasons for simple functions of either having or without indefinite integrals such as polynomial functions, rational functions, trigonometric functions, absolute value functions and irrational functions;

(3) *Conditional knowledge*: The female students can use the procedure to show that a function group has or does not have an indefinite integral but only a simple function;

(4) *Planning*: The female students can determine the hook elements a group of functions has or does not have an indefinite integral;

(5) *Monitoring*: The female students can explain a group of functions that have or do not have an indefinite integral but only a simple function; and

(6) *Evaluating*: The female students can assert that a group of functions has or does not have an indefinite integral is true but only a simple function.

Based on the interview result of this female students, then the female students have used metacognition knowledge and metacognition skills in understanding the concept of indefinite integrals in the classification category, but only on the simple function.

*Results of Female Student Interviews **the Definite Integral Concept** on the Classifying Category*

The results of female student interviews in understanding the concept of definite integrals in the classifying category as follows:

(1) *Declarative knowledge*: The female students cannot classify the intervals of a function that has or does not have a definite integral;

(2) *Procedural knowledge*: The female students cannot give a reason that at intervals certain functions have or have no integrals of course;

(3) *Conditional knowledge*: The female students cannot use the procedure to indicate that a the functional interval has or does not have a definite integral;
(4) *Planning*: Having given some examples of the female students can determine the corresponding elements of an interval on certain functions have or have no a definite integral;
(5) *Monitoring*: The female students may explain for a function interval having or no integral; and
(6) *Evaluating*: The female students have not been able to confirm that at an interval of certain functions having or not having a definite integral is true.

Based on the interview result of this female students, then the female students have not been able to use metacognition knowledge and metacognition skills in understanding the concept of definite integrals, in the classification category.

*Understanding of Male and Female Students on the Concept of Integral Calculus in the **Summarizing Category***

The answers of the male and female students in understanding the concept of integral calculus in the summarizing category can be seen in Table 3.

Table 3
The Answers of Male and Female Students in Understanding the Concept of Integral Calculus in the Summarizing Category

Form of task	Answers of Students	
	Male	Female
a. $D_x[x^4]=4x^3$; $D_x[x^4+3]=4x^3$ and $D_x[x^4-2]=4x^3$ Define $\int 4x^3\ dx$	$\int 4x^3 dx = x^4 + C$	$\int 4x^3 dx = x^4 + C$
b. Given $\int_0^2 \lvert x\rvert\ dx = \int_0^2 x\,dx = F(2)-F(0)=2$ where F is the antiderivative of x. Given $\int_{-2}^0 \lvert x\rvert\ dx = \int_{-2}^0 (-x)\ dx = 2$ Define $\int_{-2}^2 \lvert x+2\rvert\ dx$	$\int_{-2}^2 \lvert x+2\rvert dx =$ $\int_{-2}^0 -(x+2)dx + \int_0^2 (x+2)dx =$ - (½(0)^2+2(0) – (1/2(-2)^2 +2(-2)) + ½ (2)^2+2(2)) = 2-4+2+4 = 4	$\int_{-2}^2 \lvert x+2\rvert dx =$ $\int_{-2}^2 (x+2)dx =$ ½(2)^2+2(2) – (1/2(-2)^2 +2(-2)) = 2 + 4 – (2 – 4) = 6 + 2 = 8

Based on the results of the answers students in Table 3, the male and female students can summarize the main points given in the form of indefinite integrals so that the answer is correct. While the summary of the main points given in the definite integrals, only female students who answered correctly, and the male students answered wrongly.

*Results of **Male Student** Interviews about Understanding the Concept of Integral Calculus on the Summarizing Category*

The result of male student interviews about understanding the concept of integral calculus on the category of summarizes consists of the concept of indefinite integrals and definite integrals:

*Results of Male Student Interviews **the Indefinite Integral Concept** on the Summarizing Category*

The results of male student's interviews in understanding the concept of indefinite integrals in the summarizing category as follows:

(1) *Declarative knowledge*: The male students can summarize the main points given in the form of indefinite integrals correctly ie $\int 4x^3\ dx = x^4 + C$;

(2) *Procedural knowledge*: The male students can give the reason that $\int 4x^3\ dx = x^4 + C$ is based on the pattern that some x^4 functions are added with a different number but the derivatives are the same;

(3) *Conditional knowledge*: The male students can use procedure to get $\int 4x^3\ dx = x^4 + C$, that is $\int 4x^3$ anti derived from function x^4 although have different constants, so result x^4 in added C;

(4) *Planning*: The male students can determine the hook elements about the results obtained from the indefinite integral is a relation, because the value of C is not single;

(5) *Monitoring*: The male students can explain easily from the summary of the main points given in the form of indefinite integrals; and

(6) *Evaluating*: The male students can emphasize that summarizing the main points given in the form of indefinite integrals to $\int 4x^3\ dx = x^4 + C$ is true.

Thus, the result of interviews the male students in understanding the indefinite integrals concepts indicate that it has used metacognition knowledge and metacognition skills in understanding the concept of indefinite integrals in the summarizing category.

*Results of Male Student Interviews **the definite Integral Concept** on the Summarizing Category*

The results of interviews of the male students in understanding the concept of definite integrals on summarizing category as follows:

(1) *Declarative knowledge*: The male students cannot summarize the main points given in form the definite integrals ie $\int_{-2}^{2} |x+2|\ dx = \int_{-2}^{0} -(x+2)\,dx + \int_{0}^{2} (x+2)\,dx = 4$ is wrong;

(2) *Procedural knowledge*: The male students cannot give the reason that the area of the function $|x + 2|$ on the interval [-2,2] is above the x-axis;

(3) *Conditional knowledge*: The male students are less able to use procedures to obtain the area of function $|x + 2|$ at the interval [-2,2];

(4) *Planning*: The male students can review their understanding that the area of function $|x + 2|$ on the interval [-2, 2] is above the x-axis;

(5) *Monitoring*: The male students can explain the steps of calculating the area of function $|x + 2|$ at the interval [-2, 2], ie $\int_{-2}^{2} |x+2| dx = \int_{-2}^{2} (x+2)\,dx$; and

(6) *Evaluating*: The male students can master the procedure to obtain results from $\int_{-2}^{2} |x+2| dx = 8$.

So, the result of interviews the male students in understanding the concept of definite integrals on summarizing category does not show knowledge of metacognition. After being reminded again of the concepts of definite integrals, students can use their metacognitive skills to understanding the concepts of definite integrals.

Results of ***Female Student*** *Interviews about Understanding the Concept of Integral Calculus on the Summarizing Category*

Results of female student interviews about understanding the concept of integral calculus on the category of summarizes consists of the concept of indefinite integrals and definite integrals:

Results of Female Student Interviews ***the Indefinite Integral Concept*** *on the Summarizing Category*

The results of female students interviews in understanding the concept of indefinite integrals in the summarizing category as follows:

(1) *Declarative knowledge*: The female students can summarize the main points given in the form of indefinite integrals correctly ie $\int 4x^3 \ dx = x^4 + C$;

(2) *Procedural knowledge*: The female students can give reasons based on the pattern that some functions of x^4 are anti-derived from $4x^3$. Also known other functions such as $f(x) = x^4 + 3$ and $f(x) = x^4 - 2$ are anti-derived, so the conclusion $\int 4x^3 \ dx = x^4 + C$;

(3) *Conditional knowledge*: The female students can use procedure to get $\int 4x^3 \ dx = x^4 + C$, that is $\int 4x^3$ anti derived from function x^4 although have different konstata, so result x^4 in added C;

(4) *Planning*: The female students can determine the hook elements about the results obtained from the indefinite integral is a relation, because the value of C is not single;

(5) *Monitoring*: The female students can explain easily from the summary of the main points given in the form of indefinite integrals; and

(6) *Evaluating*: The female students can emphasize that summarizing the main points given in the form of indefinite integrals to $\int 4x^3 \ dx = x^4 + C$ is true.

So, the result of interviews the female students in understanding the indefinite integrals concepts indicate that it has used metacognition knowledge and metacognition skills in understanding the concept of indefinite integrals in the summarizing category.

Results of Female Student Interviews ***the Definite Integral Concept*** *on the Summarizing Category*

The results of interviews of the female students in understanding the concept of definite integrals on summarizing category as follows:

(1) *Declarative knowledge*: The female students can summarize the main points given in form the definite integrals i.e. $\int_{-2}^{2}|x+2|\ dx = \int_{-2}^{0} -(x+2)\,dx + \int_{0}^{2}(x+2)\,dx = 4$ is wrong;

(2) *Procedural knowledge*: The female students cannot give the reason that the area of the function $|x + 2|$ on the interval [-2,2] is above the x-axis;

(3) *Conditional knowledge*: The female students are less able to use procedures to obtain the area of function $|x + 2|$ at the interval [-2, 2];

(4) *Planning*: The female students can review their understanding that the area of function $|x + 2|$ on the interval [-2, 2] is above the x-axis;

(5) *Monitoring*: The female students can explain the steps of calculating the area of function $|x + 2|$ at the interval [-2, 2], i.e. $\int_{-2}^{2}|x+2|dx = \int_{-2}^{2}(x+2)\,dx$; and

(6) *Evaluating*: The female students can master the procedure to obtain results from $\int_{-2}^{2}|x+2|dx = 8$.

So, the result of the female student's interviews in understanding the concept of definite integrals on summarizing category does not show knowledge of metacognition. After being reminded again of the concepts of definite integrals, students can use their metacognitive skills to understanding the concepts of definite integrals.

The above results show that there are differences in metacognition profiles between male and female students in understanding the concept of integral calculus, especially the definite integral concepts of the classification category. The male students can use metacognition knowledge and skills in understanding the definite integral concepts, whereas the female students have not been able to use metacognition knowledge and metacognition skills in understanding the concept of a definite integral. This is different from previous research that is in the category of interpreting that the male students can only use knowledge of declarative metacognition in understanding the concept of a definite integral. While the female students can use metacognition knowledge and metacognition skills in understanding the integral concepts of course (La Misu, 2017).

The gender differences in the interpreting category are influenced by motivation and craft factors in learning mathematics, as explained by Mitsos and Browne that female have better learning achievement rates than male, as female are more motivated and work more diligent than men in doing school work (Haralambos & Horlborn, 2004). While the gender differences in the classification category is influenced by the domain of certain self-concept, especially self-concept for solving math problems. Based on the results of the study that men reported higher self-concept of mathematics than women (Casey et al., 2001; Good et al., 2012; Kung & Lee, 2016), and beliefs about mathematical self-efficacy and fear of failure, where male students' self-confidence is greater than female students (Louis & Mistele, 2012; Ross et al., 2012). In addition, when viewed from the relationship between gender and mathematical achievement shows that boys tend to perform better than girls (Bassey et al., 2011; Butt & Dogar, 2014; Marsh & Yeung, 1997; Ross et al. , 2012). Recent research shows that men continue to outperform women in mathematical achievement, especially on more difficult items (Ross et al., 2012). Similarly, research from Ching-Yi Lee & Hsin-Yi Kung (2017) relates to gender differences in the self-concept of mathematics that there are significant gender differences with regard to self-concept and mathematics, ie there is gender inequality in learning mathematics for Taiwan high school students.

Furthermore, in the summarizing category there is no difference in metacognition profile between male and female students. However, they are still weak in mastering the concept of definite integrals, especially in imagining a particular area of function whether it is above or below the x-axis. In addition, in applying a theorem to a particular case the student does not pay attention to the conditions that meet the theorem's rules. This shows that the knowledge of mathematics education students about integral calculus especially the concept of a definite integral to the category of summarizing is still low.

CONCLUSION

Based on the results of the research and discussion above, it can be concluded that: *First*, in the classifying category, the male and female students can use knowledge and metacognition skills in understanding the concept of indefinite integrals. While the definite integrals concept, only the male students can use metacognition knowledge and metacognition skills, while female students have not been able to use metacognition knowledge and metacognition skills. *Second*, in the summarizing category, the male and female students can use metacognitive knowledge and metacognition skills in understanding the concept of indefinite integrals. While the definite integrals concept, only female students can use metacognition knowledge and metacognition skills, while the male students have not been able to use metacognition knowledge.

SUGGESTIONS

Some prescriptive actions may be proposed. Assessment of the components of metacognition differs from the usual assessment. Anderson & Krathwohl (2001), suggested that it is difficult to assess metacognition skills using simple paper measurements (paper and pencil measure). Preferably objectives related to metacognition knowledge can be tested in the context of classroom activities and discussions of varying strategies. One of the fundamental problems in learning the field of metacognition is to develop and use the right tasks to measure metacognition ability. This is because assessing metacognition ability means assessing metacognition knowledge and experience or setting metacognition (control and evaluation). According to Panaoura (2005), one common approach to measuring metacognition ability is to ask students directly about what they know or do. To assess students' metacognition control, they are asked to voice their thoughts (think aloud) about what to do and think about in solving problems. Furthermore, Sjuts (1999) explains that success in learning mathematics can be known through metacognition activities. Some aspects of metacognition can be developed with metacognition strategies such as problem solving in pairs (pair problem solving). In practice one student talks about the problem by describing the thought process, the partner hears and asks to help clarify his thoughts.

Another strategy proposed is a strategy developed by Kelly (2006) that is to train students about metacognition thinking to help students converse as long as they solve problems cooperatively. This strategy is called THINK (Talk, How, Identify, Notice, Keeping). Students discuss the problem that begins with "T-Talk". They describe the situation that occurs in the problem and explain what is being asked and identify important information. Next, it focuses on the "H-How", how the problem can be solved. In addition to exchanging thoughts (ideas) to solve problems students are also asked to decide and explain why they think solving the problem. Furthermore, the stages of "I-Identify", identified a strategy or problem-solving plan. An important aspect here is that students are asked to think and evaluate the merits and weaknesses of the plan or strategy used. To understand students' understanding, they are asked to "N-Notice", how the strategy used helps solve the problem. Finally, students are asked to check what is done through "K-Keep Thinking" about the problem and determine whether the problem solving is meaningful. According to Kelly, based on the results of his research, the use of THINK guides is one of the metacognition exercises to guide interaction among students in solving problems.

RECOMMENDATIONS

The results of this study yielded several findings. the students on mathematics education in the early semester has not mastered the basic concepts of integral. Such as the concept of a complex function, such as the function of absolute value, integer function, logarithm function, and exponential function. Similarly, students have not been able to draw a function. This has an impact on the process of metacognition of students in completing the task of mathematics, especially integral calculus. Students have not been able to give a reason or explanation about the results of his work primarily on a rather difficult problem. Based on these findings, it is suggested to researchers and teachers of mathematics education that in teaching the concept of mathematics starting from the basic concepts then developed on difficult concepts. Furthermore, the learning process tries to implement the strategies developed by Panaoura (2005) and Kelly (2006). With the learning strategy, it is expected to train student's metacognition in completing math tasks. To assess students' metacognition control, they are asked to voice their thoughts (think aloud) about what to do and think about in solving problems. Thus, it is expected that the teacher tries the learning in order to understand what the students are thinking in completing the mathematics assignment.

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