International Journal of Multidisciplinary Research and Growth Evaluation
ISSN: 2582-7138
Received: 02-05-2021; Accepted: 19-05-2021
www.allmultidisciplinaryjournal.com
Volume 2; Issue 3; May-June 2021; Page No. 347-357

Metacognitive profile of ITB Stikom Bali students in calculus problem solving based on Gender

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Abstract
This exploratory research aims to describe the metacognitive profile of ITB STIKOM Bali students in calculus problem solving based on gender. The subjects in this study were 1 female ITB STIKOM Bali student who tends to have a feminine character with the initials Subject 1, and 1 male ITB STIKOM Bali student who tends to have masculine characteristics with the initials Subject 2. Selection of subjects was conducted through math ability tests and gender questionnaires. There were 2 research instruments, namely the main instrument was the researcher self and the auxiliary instruments were TKM (Mathematics Ability Test), TPMK (Calculus Problem Solving Task), interview guidelines, Gender Questionnaire. The selection of this research subject can represent the population of ITB STIKOM Bali students who take the Calculus course because it is in accordance with qualitative research procedures, in which an in-depth analysis to the characteristic similarity of the research subject and there was a linkage to the object under study. Retrieval of research data was conducted through task-based unstructured interviews. The validity testing of the data used time triangulation. Data analysis through several stages, (1) valid data input, (2) data categorization / classification, (3) data reduction, (4) data display / data presentation, (5) data interpretation, (6) conclusion. Based on the results of the analysis, it showed that female and male ITB STIKOM Bali students have the same profile of metacognitive abilities in calculus problem solving, the difference appears when each student stated the reasons for the process of solving calculus problems.

Keywords: Metacognitive, Problem Solving, Calculus

Introduction
Along with the development of cognitive psychology, the lecturers' way evaluate the achievement of learning outcomes, especially in the cognitive domain, has also developed. Currently, lecturers in evaluating the achievement of learning outcomes only emphasize cognitive goals without paying attention to the cognitive processes dimensions, particularly metacognitive knowledge and metacognitive skills. As a result, efforts to introduce metacognition in solving mathematical problems are less or even tend to be ignored. There are three ways to explain metacognition in mathematics learning, namely: (a) belief and intuition, (b) knowledge of thought processes, and (c) self-awareness (self-regulation) [1]. Beliefs and intuition regarding what mathematical ideas are prepared to solve mathematical problems and how these ideas shape the ways to solve mathematical problems. Knowledge of thought processes involves how accurately a person expresses his thought process. Meanwhile, self-awareness or self-regulation concerns one's accuracy in maintaining and managing what to do when solving mathematical problems, and how accurately a person uses input from his observations to direct problem-solving activities. Research on "Metacognition in Mathematics Education" produced several findings, namely: (a) Metacognition has an important role in problem solving; (b) Students are more skilled in solving problems if they have metacognitive knowledge; (c) In the framework of problem solving, teachers often emphasize specific strategies for solving problems and pay less attention to the important features of other problem-solving activities; (d) Teachers express impressively some of the more attainments at secondary level in primary schools where they are important in mathematical reasoning and problem-posing strategies [2].
The initial description related to students' metacognitive abilities in solving calculus problems was obtained by making preliminary observations on students of Institut Teknologi dan Bisnis (ITB) STIKOM Bali who took calculus courses and were randomly selected. The students description of Institut Teknologi dan Bisnis (ITB) STIKOM Bali in solving calculus problems was obtained by giving irregular problems regarding the application of calculus. The results of student work identify things that were known and asked and explain the condition of the problem through image illustrations but not complete. Based on the results of their work, it was found that there were students who already understood and could solve the problem and when interviewed could explain their thought process again, but there were also students who were confused about solving the problems given, so that when interviewed they were also confused in explaining their work again.

This shows that there is a possibility that a condition exists where there are students of Institut Teknologi dan Bisnis (ITB) STIKOM Bali who experience difficulties in the context of metacognition, which can have an impact on developing thinking and reasoning skills and the ability of these students to carry out the problem-solving process so that it eventually becomes a problem for him when utilize calculus concepts in other related subjects. This is in accordance with Sumarna's opinion which states that when students have difficulties in the context of metacognition, it will affect the students' ability to reason and think [3].

Basically, in the assimilation and action of information in solving mathematical problems, students have various characteristics. Therefore, in the learning process it is necessary to get attention by the teacher. The difference in solving problems is influenced by many things, including gender. Individual differences in cognitive capacity and motivation are also influenced by broader socio-cultural factors. Social influence is not explained explicitly so it is possible that it is also influenced by gender factors. Because gender is a characteristic of every individual which is inherent in both men and women which is constructed socially and culturally [4]. Gender is one of the factors that influence the conceptualization process in mathematics learning [5]. The mathematical reasoning of female students is different from the boys [6]. Gender differences in this case indicate that there are differences in understanding between mathematical concepts, differences in mathematical knowledge and of course affect metacognition and result in calculus problem solving. This is supported by the results of the 2015 TIMSS which shows the results of the achievement of grade 4 elementary school students in terms of gender for 49 countries which show that girls are superior in answering data presentation questions while boys are superior in answering numeric questions and also better at Geometry [7]. This gender difference generally occurs in senior secondary schools, and in tertiary institutions and varies in different mathematics assignments [8-10]. Based on some of these opinions, it can be said that each gender has advantages in the aspects needed to complete the given task. Because solving calculus problems involves metacognitive abilities so it strengthens the assumption and indicates that there is a tendency for gender differences to also affect students' metacognitive skills in solving calculus problems. Based on descriptions and explanations related to the importance of metacognitive abilities in solving problems for students and how gender differences lead to differences in students' metacognitive abilities, researchers are encouraged to ask fundamental questions about how the metacognitive abilities of students at Institut Teknologi dan Bisnis (ITB) STIKOM Bali in solving calculus problems if reviewed based on gender.

2. Methods

Broadly speaking, the implementation procedure in this study consists of three stages, namely: (1) preparation, (2) implementation stage, and (3) data analysis stage. The following is a brief explanation of each research stage in question.

1. The activities carried out in the preparation stage were: a) determining the research location and surveying the research location, b) examining metacognitive theory by conducting literature studies related to topics from various sources, c) developing research instruments, namely compiling research instruments used for research the data collection at the research implementation stage, d) carry out validation by experts, e) analyze the results of the validation.
2. At the implementation stage the activities carried out were: a) The selection of subjects was done randomly by considering the level of mathematical ability as measured by paying attention to the score of the mathematics test results. Researchers selected ITB STIKOM Bali students with equal abilities, namely in the moderate category based on the test scores obtained by students according to the grouping results. Furthermore, a gender questionnaire was given to get groups of students categorized as female and male. The subjects on this research were selected by 2 students, namely one female subject with moderate math ability and one male subject with moderate math ability with the aim of seeing whether there are differences in the metacognitive profiles of female students and male students in solving calculus problems, b) giving problem solving tasks and Interviewing the subject with the aim of knowing the metacognitive profile of ITB STIKOM Bali students in solving calculus problems, c) triangulating data.
3. At the data analysis stage, the activities carried out were following the steps of data analysis which consist of data categorization, data reduction, data presentation, data interpretation, and conclusions.

The mathematical ability test instrument was designed to describe the initial ability of the research subject. The problem solving task instrument in this instrument was the task of exploring the problem-solving abilities of students in calculus problems solving. The interview guide was used to explore more deeply the metacognitive profile of ITB STIKOM Bali students in calculus problems solving. Gender questionnaire was used to trace the role or personality of the research subject, whether the subject is classified as feminine, masculine, androgineous or undifferentieted. During the implementation of data collection, recording was carried out. The recording was carried out by the researcher both when the subject was solving a problem, and at the time of the interview.

At the data analysis stage, the activities carried out were to follow the data analysis steps consisting of data categorization, data reduction, data presentation, data interpretation, and conclusions. The stages were as follows. Categorization/classification was included as part of the abstracting process. Data categorization in this study was data grouping that has the same characteristics in each reasoning indicator at each stage of calculus problem solving. Data reduction is defined as the process of abstracting, focusing, selecting data, simplifying, and transforming data related to research questions. Reduced data were unnecessary data and were not relevant to the focus of this study. If there was data that was relevant and needed to answer the research questions, or which was considered to be interesting data will be retained, and if there was irrelevant data, then the data was collected and if necessary it can be used as verification or other findings. The data presented was the result of reduction arranged in a relationship pattern between categories so that it was easier to understand. Presentation of data was presented in narrative form, or in the form of graphs, matrices, schemes (networks), or flowcharts which contain information about metacognitive in calculus problem solving. In this study, relevant data was arranged with indicators of metaconnitive in accordance with those carried out by the research subjects. Thus it will be easier to infer information and have a certain meaning. The data presentation was carried out based on the categorization of

the data as previously stated. Data interpretation in this study can be interpreted as a process of understanding the meaning of the data that has been presented and associated with the research objectives that have been formulated based on the literature review used. Data interpretation in this study refers to understanding the meaning of metacognitive data in calculus problem solving. The final stage of the whole series of research data processing activities was a conclusion based on the findings. At this stage, based on the data that has been presented, the researcher made an explanation or gives meaning.

3. Results and Discussion

The selection of research subjects was carried out in accordance with predetermined criteria with the following steps: carrying out a written test using the Mathematical Ability Test (TKM), and giving a gender questionnaire to determine the research subject. After the subject selection steps were carried out, the research subjects were obtained, namely one female student (Subject-1) with a TKM score of 72 and one male student (Subject-2) with a TKM score of 74 in the Information Systems department. Each of the selected research subjects has an equal ability, which is included in the medium category.

The Subject-1 characteristics were: when in high school, he took private lessons, namely mathematics courses but never gave private lessons. She never taught calculus but had a fondness for calculus. Subject-1's view of calculus is a fairly difficult subject, and requires a very high level of thinking that requires being able to do analysis. Subject-1 apart from being a student, he also likes to sell online starting from women's clothes and accessories, also likes to cook and try new recipes. She likes to make up other people where these things are part of the tendency of women who are feminine. While for the Subject-2 is never taken private lessons, never taught calculus but quite likes calculus, where his view of calculus is that calculus is a material that is quite difficult to learn because it requires complex visualization and analysis to work on the problem, apart from being a student. Subject-2 also works on the spot computer repair, love sports and love to be in the automotive field where these things are part of the masculine tendency of men.

After the data was collected according to the data collection procedure, then to make it easier to analyze, the data collected was labeled to facilitate the complete presentation of the data. The data labeling was given the following symbol.

Symbol: P/S F/M T 1 01

Digit : 1 2 3 4 5

Symbol description

1. = Interviewer/Subject Response
2. = Subject-1 / Subject-2
3. = Polya's Problem Solving Stage
4. = Calculus Problem Solving Tasks (TPMK) 1 or (TPMK) 2
5. = Problem Number –l

For example, when a data set is coded "PFT101" then this means that the Subject-1 interviewer data is at the stage of understanding the problem with the Calculus problem solving task (TPMK) 1 and is question number one, which is labeled ``PF '', on the researcher's question, in Interview Subject-1, at the stage of understanding the TPMK 1 problem was labeled "T1", in question number one it was labeled "01". Thus, the form of the label in general for the answer to Subject-1 is: "SFT1101", so this means that the data is the respondent or the answer to Subject-1 at the stage of understanding the problem with the problem solving task (TPMK 1) and is the number one answer.

As for the coding of research data as follows: to state the stage of understanding the problem (Understanding Problem) is denoted by the letter U, for the stage of making a plan (Devising a Planning) it is denoted by the letter Pl, for the stage of implementing the plan (Carrying out the plan) it is denoted by the letter Cr, for the stage of checking back (Looking back) denoted by the letter Lb. For example, SFU means the sentence that has the code comes from the Subject-1 category of understanding the problem. The metacognitive category in problem solving can be seen in Table 1.

Table 1: Metacognitive Category in Calculus Problem Solving

Stages of Problem Solving	Metacognitive Category	Code
Understanding Problem	*(Tacit Use)* Give an explanation of the understanding obtained after heed to a calculus problem. Recognizing the need for a conscious effort to understand the calculus problem, it expressed in logical arguments. Pay close attention to the importance of calculus problems in life, it expressed with logical arguments. Recognizing that Calculus problems solving can attract interest in learning, it expressed in logical arguments.	U1 U2 U3 U4
Devising a Planning	*(Strategi Use)* Have a strategy about what needs to be done to study thoroughly when starting to solve a calculus problem, it expressed with logical arguments. Paying close attention to all parts of the form of understanding obtained about calculus problems in order to plan the solution to the problem, it expressed by logical arguments. Able to formulate a form of understanding of calculus problems, it expressed with logical arguments.	P11 P12 P13
Carrying out the plan	*(Aware Use)* Recognizing the form of Calculus problems that must be done systematically, it expressed with logical arguments. Knowing how much effort must be made to solve a calculus problem, it expressed with logical arguments. Have a clear idea of what you want to learn from solving a calculus problem, it expressed with logical arguments.	Cr1 Cr2 Cr3
Looking back	*(Reflective Use)*	

	Solve Calculus problems by conducting self-examination of the systematics of answers, it expressed with logical arguments.	Lb1
	Recognizing mistakes when solving problems, it expressed with logical arguments.	Lb2
	Evaluating the systematic of calculus problems solving that have been done, it expressed with logical arguments.	Lb3

At the stage of understanding the problem, the subject is given TPMK and given the opportunity to read and understand it. The TPMK used were as follows.

TPMK

A factory has the capacity to produce refrigerators every day from 0 to 100. Daily overhead costs for the factory are IDR 2.200.000 and direct costs (employees and materials) IDR Rp151.000. Write down the formula for T (x), the total cost of producing the refrigerator "x" in one day, as well as the unit cost u (x) (average cost of each refrigerator)!

Then TPMK-based interviews were conducted to determine the metacognitive abilities of Subject-1 and Subject-2 in solving calculus problems, with the following results.

1. **Metacognitive Profile of Subject-1 at the stage of understanding the problem**

   Subject-1 understands the problem by providing an explanation of the understanding obtained after listening to a calculus problem, namely by saying that there is a factory operating cost that can be translated into a function. When more refrigerators are produced, the factory operating costs will increase. This is in line with the research results of Lestari et al. that the metacognitive abilities of students at the stage of understanding the problem, students make an effort to understand the problem begins with reading the problem [11].

   In line with the research results obtained Bakar and Ismail which stated that Subject-1 at the stage of understanding the problem can understand the calculus concepts that exist in the problem, namely the derivation of linear functions with a fairly logical explanation [12].

   Subject-1 realized the need for a conscious effort to understand the problem of calculus with its logical argument, namely to reveal what was known about the problem, first, factory overhead costs were IDR 2.200.000 and direct costs were IDR 151.000. Both factories produce a maximum of 100 refrigerators per day. The unit refrigerator that the factory produces each day is related to direct costs. Because on the written issue the direct costs are for employees and materials. This means that the more refrigerators produced, the more materials and energy needed. The reason is that the problem is clearly stated, for example in the form of numbers. Subject-1 told what is related to what is known and why it is logical. Because what was mentioned by subject-1 was in accordance with the problem given, the reason stated was also logical because it is in accordance with the actual situation. The same was stated by Susanah that the female subject with mathematical ability is at the stage of understanding the theorem can reveal what is known and what will be proven in the theorem with logical reasons, because the subject with mathematical ability is saying a statement after the word of "if" and before the word of "then" it is information that is known and the statement after the word of "then" is information to be proved on the theorem [13].

   Subject-1 paid close attention to the importance of calculus problems in life which was expressed with a logical argument that reveals that in this problem there are questions, namely the total cost of production and the unit cost of products produced every day. The reason was because in this problem there are message sentences such as the word of "write down" and an exclamation mark symbol. What was expressed by Subject-1 was logical because in the problem in question it is in accordance with the actual situation in the problem. And the reasons given by Subject-1 were logical because in the problem there is a word of "write down" which states it as orders to answer the problem. What was revealed by Subject-1 related to what is asked and the reason is logical because what Subject-1 reveals is in accordance with the facts on the problem, the reasons put forward by Subject-1 were also logical because of the reasons put forward by the Subject- 1 in accordance with the facts on the matter. The reason given by Subject-1 was also logical because the subject tended to pay attention to the key words in the problem, namely the word of "write down" and the exclamation mark symbol. This is in line with the opinion expressed by Polya that the things that are included at the stage of understanding the problem include identifying things (information) that are known and things that are questioned in the problem [14]. According to Pape, the behavior of female subjects who are capable of understanding the problem is categorized Direct Translation Approach (DTA) [15].

   Subject-1 realized that solving calculus problems could attract learning interest along with its logical argument, namely that revealing the information given (which was known) in the problem was sufficient to answer the question. The reason was that from what is known on the problem can already represent the answer. Subject-1's expressions and reasons related to the known information to answer the problem are logical. Because it was appropriate to find the total cost of the product and the unit cost in one day. Based on that information it was developed to find the formula of what was being asked in the problem. This is in accordance with Polya's opinion that what is at the stage of understanding the problem includes checking whether the problem meets the conditions and is sufficient to determine the things that are questionable, excessive or contradictory [14]. The things mentioned above are in line with the results of Sukayasa's research that the subject focuses on what is known and asked in the questions and is able to provide logical reasons why it is necessary to pay attention to these things along with their logical arguments [16].

   At the stage of understanding the problem, subject-1 already has the Tacit Use domain metacognitive ability, namely understanding the problem by providing an explanation of the understanding obtained after listening to calculus questions; Recognizing the need for a conscious effort to understand calculus problems with logical arguments; note the importance of calculus problems in life revealed by logical arguments; As well as determining and describing or using relationships between variables or objects in mathematical situations, namely the category of realizing that calculus problems solving can attract learning interest and logical argumentation.

2. **Metacognitive Profile of Subject-1 at planning stage**

   Subject-1 had a strategy about what needs to be done to study thoroughly when starting to solve a calculus

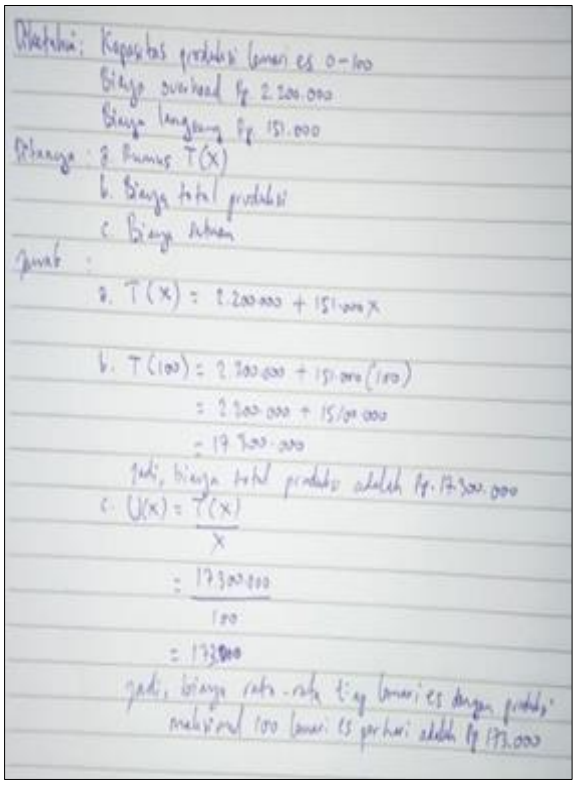
problem. Namely revealing the plan, by first rewriting what is known about the problem. Second she wrote down what is asked of the problem. Third, she made a sketch if needed and finally determine the formulas that will be used. Subject-1 revealed the reason why she wrote what was known was to make it easier to enter the numbers in the formula, because it was clearly detailed. Subject-1 revealed the reason why writing what is being asked is to make it easier, because what is written is the essence of the question so that it is easy to understand. Subject-1 explained a sketch is a picture made to represent the words of the problem. Subject-1 revealed the use of sketches, which is to make it easier to solve problems. This is in accordance with Wheeler's opinion that one strategy in solving the problem is to draw a picture and use a formula [17]. This is in line with the results of the research conducted by Syukriani et al. that independent female subjects in solving problems use strategies by making pictures to summarize existing data on the problem and find solutions through these images [18]. The same is obtained by Susanah that the female subject with a mathematical ability is planning the method that will be used in proving the theorem by using the information in the hypothesis along with logical reasons [13]. In line with that produced by Sukayasa that female subjects with mathematical abilities are able to choose a strategy (solution) to solve problems [16].

Subject-1 paid close attention to all parts of the form of understanding obtained about calculus problems to plan for solving the problem along with its logical arguments, by revealing the formulas to be used, namely 1) the formula for calculating the total cost of production and 2) the formula for calculating the average cost of the results production. Subject-1 said the formula for calculating the total cost of production is "total cost of production = overhead + direct costs x production of the product". Subject-1 revealed the formula for calculating the average cost of production is "the average cost of production = (total cost of production) / (amount of production of products per day)". Subject-1 revealed that in general overhead costs are fixed costs that must be incurred by the factory. This is in line with the research results by Syukriani et al. that the female subject processes several forms of images by combining the same two forms, using relevant formulas and implementing these formulas, and interpreting the results obtained [18]. In line with the results obtained by Udil et al. that female subjects with mathematical abilities are able to recognize calculus concepts (mentioning several function concepts that will be used to solve problems, namely function operations, function properties and complete composition of functions). She is able to determine the calculus concepts needed to solve problems, namely the concept of operating functions in deriving formulas and applying the properties of linear functions [19]. The same is stated by Susanah that the moderate capable female subject plans the method that will be used in proving the theorem by using existing information with logical reasons [13].

Subject-1 was able to formulate a form of understanding of calculus problems, namely to reveal the reasons for using the plan that will be used are appropriate to solve the problem, namely starting to write down what is known, asked, and the formulas to be used, namely the formula for calculating the total cost of production and the formula for calculate the average cost of production. This is in line with the research results obtained by Sukayasa that female subjects with moderate mathematical abilities are able to identify the materials (determine the concepts) needed in solving problems, namely the concept of function operations in deriving the formula and applying the properties of linear functions [16]. Furthermore, Sukayasa said that female subjects with moderate mathematical abilities are capable of making logical arguments in solving problems. Likewise Polya's opinion that at the stage of making plans, is there a relationship with the problem, whether the sequence of steps used is correct [14].

Based on this, it showed that at the stage of making plans, Subject-1 already had metacognitive abilities with the Use Strategy domain, namely by the category of investigating the information provided and selecting the mathematical facts needed to solve mathematics. That is, the category of she had a strategy about what needs to be done to study thoroughly when starting to solve a calculus problem and its logical arguments. She combined various mathematical procedures to obtain results and combine results to produce more complex results. That is, with the category of paying close attention to all parts of the form of understanding obtained about calculus problems to plan solving the problem and its logical arguments and making connections or connections between different elements of knowledge and related representations. And make a link between related mathematical ideas, namely by being able to formulate a form of understanding of calculus problems, expressed with logical arguments.

3. Metacognitive Profile of Subject-1 at the stage of implementing the plan



Subject-1 had implemented problem solving according to plan along with logical arguments, namely working on

TPMK. Subject-1 solved the TPMK problem, by writing down what was known and what was asked. At its completion, it uses four steps, namely forming a formula to determine the total cost of production, determining the value of the total cost of production, forming a formula for determining average costs, determining the average cost value. This is in accordance with the research results by Sukayasa that female subjects with moderate mathematical abilities are able to apply their planned ideas to solve problems in writing in one way [16]. The same thing was obtained by Susanah that the female subject with moderate mathematical ability proves the theorem according to the plan made along with logical reasons based on the information in the hypothesis or what is known in the theorem [13].

Subject-1 used concepts and procedures in solving problems correctly along with their logical arguments, which was to provide the reason for step 1, so that those who read the answers made better understand where the numbers entered to become formulas come from. Subject-1 gave the reason for step 2, namely when someone saw the formula that was listed above. Then he/she would understand to just continue the formula that had been obtained by entering the replacement number "x". And then the answer to the value of production costs is sure to be found. Subject-1 gave the reason for step 3, which was to make it easier for someone to find the average cost so the appropriate formula must be made first. This is in line with the research results by Udil that the female subject with a moderate mathematical ability is using the function definition [19]. Basically, a function is a relation that maps each member of a set which is called the area of origin or domain to exactly one member of the other set which is called a friend area (kodomain).

Subject-1 had a clear idea of what she wants to learn from solving a calculus problem. Subject-1 concluded that the result is that the total cost of producing "x" refrigerators in one day is IDR 17.300.000 and the unit cost or average cost of each refrigerator is IDR 173.000. This is logical because it is known that the production of the refrigerator each day is 0-100 fridges. This is according to the research results by Hidayat et al. that the conclusion made by the female subjects in the step of planning to solve the problem tends to be based on general rules or deductive reasoning that builds metacognitive abilities [20]. Likewise, the results of Suhapti's research show that female subjects who are moderate capable do the activity draw conclusions and provide reasons by connecting the facts in the problem between what is known and what is being asked [21]. However, this is contrary to the results of the study by Sukayasa that female subjects with moderate abilities are unable to describe logically conclusions [16].

Based on this, it shows that at the stage of plan implementation, the Subject-1 had metacognitive abilities with the Aware Use domain, namely the category of being aware of the form of Calculus problems that must be done systematically along with its logical arguments. Category: Knowing how much effort must be made to solve a calculus problem and its logical arguments. And had a clear idea of what she wants to learn from a calculus problem solving and its logical arguments, namely making conclusions from calculations correctly and logically.

4. Metacognitive Profile of Subject-1 at the looking back stage

Subject-1 solved the calculus problem by conducting its own examination of the systematization of the answer, namely checking the steps taken. This is in line with the results obtained by Suhapti that the female subject with moderate ability is at the Looking back stage to check only by reading the questions, doing mental calculations and matching the results with the existing questions [21]. The subject did not do the rework because he was sure the answer was correct and there were no other events. This is in accordance with the research results by Susanah that the female subject with moderate mathematical abilities checks every step that has been done and revising her work that is considered incorrect [13].

Subject-1 realized an error when solving the problem, namely explaining that what was checked was the formula and numbers that were entered, whether they were appropriate and tried to count them again. The numbers in question are all the numbers in the problem because if the numbers are wrong it can make everything wrong. The formulas were also checked because the formulas used are not permanent formulas but some are derived using mathematical properties. The formula used includes T (x) = 2,200,000 + 151,000 x, it can be changed to T (x) = 151,000 x + 2,200,000 because it is the commutative property of addition, which results in the same. This is in accordance with the research results by Syukriani that the female subject looks back at the possibility of a wrong part by double checking the use appropriateness of the formula and the calculation notes [18].

Subject-1 evaluated the systematics of calculus problem solving that had been carried out, namely revealing the belief that the answer was correct. The reason is that Subject-1 performs according to the formulas and calculation operations and the results are logical. The method used to solve the problem is the simplest way. In line with the results obtained by Syukriani that looking back and reviewing the steps that have been taken in solving the problem are important activities [18]. This is related to the level of accuracy and the process of solving problems that have been carried out, which indicates that to convince someone to solve the problem by checking the results obtained.

Based on this, it shows that at the rechecking stage, Subject-1 already has metacognitive abilities with the Reflective Use domain on the Calculus problems solving category by conducting self-examination of the systematization of answers, it expressed with logical arguments. And on recognizing mistakes category when solving problems, she provided a justification for the truth or error of a statement by referring to the results or mathematical characteristics. It namely by evaluating the systematic evaluation of calculus problem solving that has been done, it expressed with logical arguments.

5. Metacognitive Profile of Subject-2 at the stage of understanding the problem

Subject-2 explained the understanding obtained after heed to calculus questions, namely by saying that the refrigerator factory requires daily overhead costs of IDR 2.200.000 and direct costs (employees and materials) of

IDR 151.000. The factory produces 0-100 refrigerators per day. This is in line with the research results by Lestari that the metacognitive abilities of students at the stage of understanding the problem, namely students make an effort to understand the problem begins with reading the problem [11]. In line with the research results obtained by Bakar and Ismail which stated that at the stage of understanding the problem, the male subject can understand the calculus concepts that exist in the problem, namely the derivation of linear functions with a fairly logical explanation [12]. However, this is not in line with the results obtained by Sukayasa which stated that the male subject with moderate ability, in the problem understanding stage at the critical thinking kind, the subject in making his arguments partly illogical and able to focus on parts of the problem but unable to provide logical reasons why it needs attention. The subject in revealing statements is less analytical and reflective, because in general the statements are less logical [16].

Subject-2 realized the need for a conscious effort to understand the problem of calculus with its logical argument, namely to reveal what is known from the problem that there is a factory that has a refrigerator production capacity of 0-100, an overhead cost of IDR 2.200.000 and a direct cost of IDR 151.000. The maximum factory can produce 100 refrigerators per day. It is possible for the factory to produce less than 100 refrigerators per day because in the problem it is written that the production is from 0 to 100 refrigerators. On the issue it is clear that these statements are things that are known. What WAs told by Subject-2 related to what is known and its reasons are logical because what is said by Subject-2 is in accordance with the actual situation on the given problem, the reasons stated were also logical because it is in accordance with the facts on the problem. The same is stated by Susanah that the male subject with moderate mathematical ability at the stage of understanding the theorem can reveal what is known and what will be proven in the theorem with logical reasons, because the male subject with moderate mathematical ability said a statement after the word of "if" and before the word of "then", it is known information. And the statement after the word of "then" is the information that will be proven in the theorem based on the theorem structure in the form of implications (13). In line with the results of research from Suhapti that the male subject with moderate ability at the understanding problem stage giving reasons that both what is known and what is being asked are his own sentences. The reasons given tend to pay attention to the meaning of the sentence as a whole (21). The behavior of male subjects in understanding the problem tends to be Meaning Based Approach (MBA) (15).

Subject-2 paid close attention to the importance of calculus problems in life with its logical argument, which was to reveal that in this problem what is being asked is the formula T (x), the total cost of production and the unit cost. This is because the statement is the essence of the question on the problem. This is in line with the opinion expressed by Polya that the things that are included at the stage of understanding the problem include identifying things (information) that are known and things that are questioned in the problem (14). In line with the research results by Suhapti that the male subject with moderate ability at the understanding stage takes a long time to provide reasons both known and asked, approximately 20 seconds, and uses his own language [21]. According to Pape, the subject's behavior in understanding the problem is included in the Direct Translation Approach category (DTA) [15].

Subject-2 realized that solving calculus problems can attract learning interest along with its logical argument, namely to reveal that the known information given was sufficient, because the information given was as well as what was known and what was being asked was all clear. This is in accordance with Polya's opinion that what is at the stage of understanding the problem includes checking whether the problem meets the conditions and is sufficient to determine the things that are questionable, excessive or contradictory [14]. The things mentioned above are in line with the research results by Sukayasa that the male subject with moderate ability focuses on things that are known and asked in the problem and is able to provide logical reasons why it is necessary to pay attention to these things along with their logical arguments [6].

At the stage of understanding the problem, subject-2 already has the metacognitive ability of the Tacit Use domain, namely investigating the information provided and selecting mathematical facts that are necessary to solve the problem, namely by giving an explanation of the understanding obtained after heeding the calculus problem and its logical arguments; Recognizing the need for a conscious effort to understand calculus problems and its logical arguments; Pay close attention to the importance of calculus problems in life and their logical arguments, and he determine and describe or use the relationships between variables or objects in mathematical situations, namely the category of realizing that solving calculus problems can attract learning interest and its logical arguments.

6. Metacognitive Profile of Subject-2 at planning stage

Subject-2 had a strategy about what needs to be done to study thoroughly when starting to solve a calculus problem. Namely, writing down what is known and asked. Then determining what formula will be used. A formula is a form of algebra that can be used as a benchmark to make it easier to understand the solution to a problem. The formula is made to make it easier for us to determine to enter the appropriate numbers in the process of finding an answer. Subject-2 revealed what is known so that what is known from the problem is more conceptualized in detail so that there is no need to read the problem over and over again, to ask questions so that solving the problem is more conceptual and easier.

This is in accordance with the research results obtained by Susanah that the male subject with moderate mathematical ability plans a method to be used in proving the theorem by using the information data in the hypothesis with logical reasons (13). The same is resulted by Udil et al. that male subjects with moderate mathematical abilities specifically for basic thinking in recognizing mathematical concepts in the problem can mention three names of mathematical concepts, namely function operations, function properties and complete composition of functions(19). In this type of critical thinking the subject in analyzing statements in solving a problem is quite logical.

Subject-2 paid careful attention to all parts of the form of understanding obtained about calculus problems to plan their problem solving. Namely Subject-2 expressed the formula to be used, namely the formula for determining

the total cost of production and determining the unit cost of production. The formula for total production costs = overhead costs + (direct costs x production of products). The formula for unit costs of production = (total costs of production) / (total production of products). Subject-2 said that no other formula would be used. This is in accordance with research Udil et al. that the male subject with moderate mathematical ability is able to recognize calculus concepts, mentions some mathematical concepts that will be used to solve problems, namely function operations, function properties and complete composition of functions. He is able to determine the function concepts needed to solve problems, namely derivation concepts of the formulas of the function form and composition of the complete function but do not apply the properties of the function. The subject is sufficiently able to identify the materials needed to solve a problem, but is unable to provide a logical reason for using the concept [19]. The same is stated by Susanah that the moderate capable male subject plans the method that will be used in proving the theorem by using existing information with logical reasons [13].

Subject-2 was able to formulate a form of understanding of calculus problems. Namely Subject-2 revealed the reasons for using his plan starting from writing down things that are known and asked, determining the formula is sufficient to find answers in solving the problem. This is in line with the research results obtained by Sukayasa that male subjects with moderate mathematical abilities are able to identify the materials (determine concepts) needed to solve problems (16). Furthermore, Sukayasa said that male subjects with moderate math abilities are capable of making logical arguments in solving problems. Subjects in synthesizing ideas to solve problems are able to determine logical relationships between ideas that have been identified in advance and are able to fully state the linkages between ideas so as to form a series of steps to solve the problem in planning the application of the idea. He used two solving events to solve the problem which are given. Likewise Polya's opinion that at the stage of making plans, is there a relationship with the problem, whether the sequence of steps used is correct [14].

Based on this, it showew that at the planning stage, Subject-2 already had metacognitive abilities with the Use Strategy domain. Subject-2 investigated the information provided and selects mathematical facts that are necessary to solve mathematics. Namely the category: he has a strategy about what needs to be done to study thoroughly when starting to solve a calculus problem and its logical arguments. Subject-2 combined various mathematical procedures to obtain results and combined results to produce more complex results. Namely, with the category of paying close attention to all parts of the form of understanding obtained about calculus problems to plan solutions to problems along with their logical arguments. As well as making links or connections between different elements of knowledge and related representations and making links between related mathematical ideas. Namely, the category is able to formulate a form of understanding of calculus problems.

7. Metacognitive Profile of Subject-2 at the stage of implementing the plan

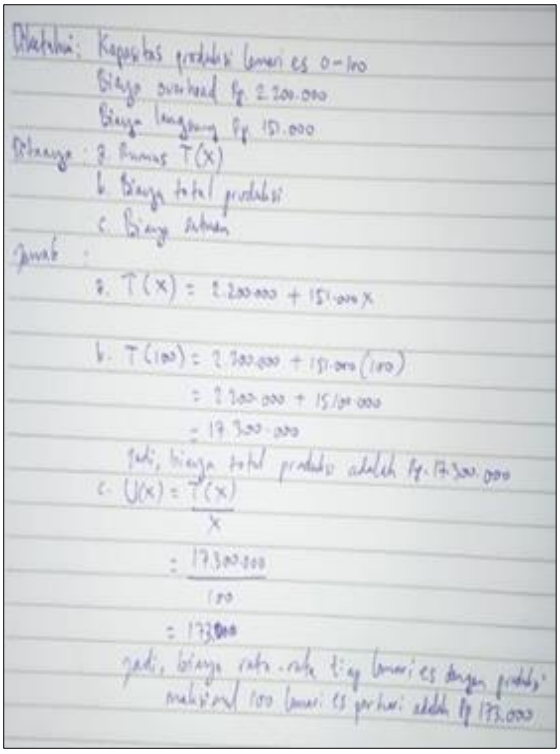


Fig 1

Subject-2 had realized the form of Calculus problems that must be done systematically along with its logical arguments. Subject-2 solved the TPMK problem, by writing down what was known and what was asked. In its completion, it uses four steps, namely determining the formula for finding the total cost of production, calculating the total cost of production, determining the formula for finding the unit cost of production, calculating the unit cost of production. This is in accordance with the research results by Suksyasa that the male subject with moderate mathematical ability is able to apply his planned ideas to solve problems in writing in two ways. The subject concludes what is known by pointing at the question and then reading it completely and pointing to the words that were read with the reason "this is a question" Similarly, concluding what was asked, namely "a lot of plastic bags are needed" with the reason "Yes, the problem is that" [16]. The same thing was obtained by Susanah that the male subject with moderate mathematical ability proves the theorem according to the plan made along with logical reasons based on the information in the hypothesis or what is known in the theorem [13].

Subject-2 knew how much effort must be made to solve a calculus problem and its logical arguments. Subject-2 revealed that T (x) = total cost of production, U (x) = unit of production, and x = number of products produced. Subject-2 saaid that T (x) and U (x) are not standard symbols, it is possible to change the shape of the letters as needed. Subject-2 said to use these symbols because they were what was written in the questions. That which

is used to represent the total cost of production and the unit cost of production is T (x), and U (x). Subject-2 gave the reason for making step 1 is to make it easier to enter the appropriate numbers into formulas, thus making it easier to understand the solution to a problem. Subject-2 gave reasons for writing the formula T (x) = 2,200,000 + 151,000 x. The last "x" cannot be moved behind the number 2,200,000. Because "x" represents the number of products produced, while 2,200,000 are overhead costs and we already know that overhead costs have nothing to do with the production carried out. So it is not correct to determine the formula with the form T (x) = 2,200,000 x + 151,000. Subject-2 gave the reason for step 2 that according to the formula for determining the total cost of production is T (x) = 2,200,000 + 151,000 x. So it remains only to continue the formula by substituting the applicable x value to get the total cost of production. Subject-2 said that the value of 100 which is used as the value of x is in accordance with the problem that the factory produces a maximum of 100 refrigerators per day. Subject-2 answered that 15,100,000 were direct costs of the refrigerator factory which had been adjusted to the number of products produced by the factory, namely 151,000 x 100 = 15,100,000. Subject-2 answered that the 17,300,000 was obtained by adding up 2,200,000 to 15,100,000. Based on this data it can be concluded that Subject-2 provided a logical rationale for step 3 that in order to determine the unit cost we need to derive the formula first. Then from the formula for the total cost of production was in accordance with the relationship. This is in line with the research results by Susanah that the male subject with moderate mathematical ability is using the definition of the weight line and the theorem based on the theorem which states that if the ratio of the lengths of the segments on the corresponding sides of the triangle is the same, the line that intersects the two sides of the triangle is parallel to the third side [13].

Subject-2 had a clear idea of what he wanted to learn from solving a calculus problem. Subject-2 said that the total production cost of the refrigerator factory was IDR 17,300,000, and the unit cost of the refrigerator produced by the factory was IDR 173,000. This is match to the research results by Hidayat et al. that the conclusion made by the male subject with moderate mathematical ability in the step of planning to solve the problem tends to be based on general rules or deductive reasoning [20]. Likewise with the research results by Suhapti that the male subject with moderate mathematical abilities on activity of drawing conclusions and providing reasons, it is done by linking the facts in the problem between what is known and what is asked [21]. However, this contradicts with the results of the study by Sukayasa that male subjects with moderate mathematical abilities are able to describe conclusions logically and the arguments created are quite logical [16].

Based on this, it showed that at the stage of implementing the plan, Subject-2 already had metacognitive abilities with the Aware Use domain, namely the category of being aware of the form of calculus problems that must be done systematically. Categories know how much effort they have to take along with their logical arguments. And the category has a clear idea of what he wants to learn from solving a calculus problem, expressed by logical arguments.

8. Metacognitive Profile of Subject-2 at the stage of rechecking

Subject-2 solved calculus problems by conducting self-examination of the systematization of answers, namely checking the steps that were carried out. This is in line with the research results obtained by Suhapti that the male subject with moderate ability at the Looking back stage, he do the check only by reading back the problem slowly and observing the answer while pointing at the intended one from start to finish. He conducts an examination without doing a written calculation but doing a mental calculation, he does not do the recalculation because he sure the results are correct and there is no other way [21].

Subject-2 realized mistakes when solving the problem, namely explaining that what was checked was the formulas, numbers and calculations. Subject-2 revealed the reason for checking the formulas, namely to avoid mistakes in deriving the formulas. Subject-2 said that T(x) = 2,200,000 + 151,000 x, can be changed to T(x) = 151,000 x + 2,200,000, because it is a commutative addition, the result is the same. This is in accordance with the results of the study by Suhapti that the male subject at the stage of rechecking performs an examination by checking the numbers that are operated and calculating the results mentally [21]. This is in accordance with the results of the study by Sykriani et al. that the male subject at the stage of looking back may have made a mistake by re-checking the suitability of the picture, using formulas and calculations, re-examining the formula used which includes the input of the numbers, and the order in which he is done [18].

Subject-2 evaluated the systematics of solving calculus problems that had been carried out, namely revealing the belief that the answer was correct on the grounds that it had worked according to the formula and calculation operations and the results are logical. The method used to solve the problem was even the simplest. In line with the results obtained by Suhapti that the subject believes the result is correct on the grounds that the result is constant and there is no other event [21]. Syukriani et al. stated that looking back and reviewing the steps that have been taken in solving the problem are important activities. This is related to the level of accuracy and the problem-solving process that has been carried out, which indicates that to convince someone to solve the problem by re-checking the results obtained [18].

Based on this, it showed that at the stage of rechecking Subject-2 already had metacognitive abilities with the Reflective Use domain in the category of solving Calculus problems by conducting their own examination of the systematic answers. Category was aware of mistakes when doing troubleshooting. As well as providing a justification for the truth or error of a statement by referring to the results or mathematical properties, namely by evaluating the systematic evaluation of calculus problem solving that had been done.

Based on the discussions above, at the stage of understanding the problem in general, it can be said that the metacognitive abilities of female subjects and male subjects in solving problems were relatively the same. Although in certain aspects of the reasoning of the female subject and the male

subject there were differences. The prominent difference between female subjects and male subjects was in providing an explanation of the understanding gained after listening to a calculus problem. This means that male subjects tend to express their understanding more fully. In the category of realizing the need for a conscious effort in understanding the problem of calculus the difference was only when expressing the reasons why what was revealed was be known. In the category of paying close attention to the importance of calculus problems in life, the difference was when revealing the reasons. Where the female subject said the reason there was a written word and an exclamation mark symbol, while the male subject said because the statement was the essence of the question on the problem. In the category of realizing that solving calculus problems can attract interest in learning the difference when revealing the reasons. Where the female subject said the reason for what was known in the problem was able to represent to answer. Meanwhile, male subjects said the reasons were all clear from what was known and what was asked. The results of the research that appear between female subjects and male subjects are that both of them have equal metacognitive abilities in solving calculus problems, this is in line with the results of research conducted by Heinze and Reiss which said there was no significant difference between male and female subjects in math ability [22]. In line with the results obtained by Turğut and Yılmaz said that there is no significant difference between male students and female students in spatial ability [23]. However, the results of this study are not in accordance with what is stated by Geary et al. who said that male subjects were superior in mathematical reasoning who said that male subjects were superior in mathematical reasoning [24].

At the planning stage, there are differences in metacognitive abilities between female and male subjects. In the category of having strategies about what needs to be done to study thoroughly when starting to solve a calculus problem, female subject revealed planning strategies with reasons, reasons why write down what is known and then what is asked then explain sketches and their uses, while male subject revealed planning strategies and the purpose of determining the formula and then revealing the known and asked reasons. In the category of paying close attention to all parts and formulating the form of understanding obtained about calculus problems to plan the solution of the problem, the difference is also when revealing the reason. Where the female subject revealed the reason for using the plan that would be used was appropriate to solve the problem, while the male subject revealed the reasons for using such a plan because starting from determining the formula, writing down things that were known and being asked was enough to find answers in solving the problem. This is in line with the results of research studies by Zhu which stated that there are differences in solution strategies between male and female students in solving math problems related to cognitive abilities [25]. The same thing was stated from the research results Hidayat et al. which said that there are differences between female subjects and male subjects with moderate abilities in the process of thinking when solving problems and assimilating the problems given [20]. This is also in line with the opinion of Meyers-Levy which stated that there are differences in cognitive processes between girls and boys in solving math problems.

At the stage of implementing the problem solving plan carried out by the two subjects using the same reason by using a formula that had been determined as planned. Differences in the metacognitive profile of subject-1 and subject-2 in solving problems at the stage of implementing the plan occurred when the subject explained the plan that was carried out to solve the problem, where subject-2 explained in detail how to solve it. At the rechecking stage, the two subjects rechecked both, the numbers, the formula used and the calculations. In general, the checks carried out were almost the same for both subject-1 and subject-2, only that the reasons given were related to the reasons for re-checking, subject-1 explained more in detail and clearly than subject-2.

4. Conclusion

The female and male ITB STIKOM Bali students have similar metacognitive abilities in solving calculus problems (based on Polya's stages), namely having logical, structured and dynamic metacognitive abilities, the difference appears when each subject states the reasons for the process of solving calculus problems (based on Polya stage). This study focused on the metacognitive properties of the subject in problem solving, but did not specifically examine the metacognitive impact the subject had on the completeness of the answers obtained by the subject. It has not been studied whether the completeness of the answers given by the subject is influenced by the metacognition of the subject. So it is recommended that further research be conducted to conduct research on the impact of metacognitive on the completeness of answers.

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