

Students 'Critical Thinking Profile To Solve The Problem Of Analytical Geometry Viewed From Gender

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Abstract

This study aims to describe the profile of students' critical thinking in solving analytical geometry problems that are viewed from gender. This research is a qualitative study with case studies. Data analysis technique used are Miles and Huberman analysis, namely data reduction, data presentation, and presented conclusions. The results of this study are male students and female students who have met the standard eight intellectual critical thinking standards of analytical geometry, namely clarity, precision, accuracy, relevance, consistency, logical correctness, completeness, and fairness. On the intellectual standard of precision, male students were more careful in giving reasons for taking problem solving strategies to female students. At the intellectual standard of fairness, male students are able to provide two alternative solutions to problems, while female students only provide one initial solution to problem solving.

Keywords: Critical Thinking; Gender; Geometry; Solution to problem

INTRODUCTION

Solving problems is a basic activity for humans or high mental activity, most of a person's life is faced with problems, so it is necessary to find a solution (Hudojo, 2003). In solving problems, students are required not only to think simply, but students should be able to think critically. Critical thinking means thinking clearly and intelligently. The purpose of this is a general term for various cognitive skills, and intellectual dispositions needed to effectively identify, analyze and evaluate arguments and claims of truth. (Bassham, Irwin, Nardone, & Wallace, 2010) Critical thinking aims to find and overcome personal prejudices and biases, form and present convincing reasons to support conclusions, and make intelligent decisions about what is believed and what to do.

This ability must be applied in lectures. Analytical geometry is one of the subjects that must be taken by students of the Widya Dharma University Mathematics Education Study Program. In the course, students not only learn about how to interpret these geometric objects in the field of cartesian coordinates, but students also learn to analyze the relationship of the coordinate points of these objects using algebraic equations. Students are required to be able to think critically in order to solve the problem of analytic geometry precisely and accurately, argue with the support of logical and strong evidence, think clearly and wisely, and draw conclusions by testing information data using the scientific method. Men and women have different characteristics, including ways of thinking called gender differences. Gender refers to the roles and responsibilities of men and women in the family, society and culture. There are differences in the ability of male students and female students to solve a problem (Fitriani, Jalmo, & Yolida, 2015). Therefore, it is necessary to do research on the profile of students' critical thinking in solving analytical geometry problems by reviewing gender differences.

Based on previous research, many studies have been conducted on improving the ability of critical thinking skills or analyzing students' critical thinking (Adiwijaya, Suarsini, & Lukiati, 2016; Alfi, Sumarmi, & Amirudin, 2016; I. W Anita, 2015; Dewanti, 2018; Haryani, 2012; Huda, Susilo, & Sa'dijah, 2017; Imawan, 2015; Pratama & Prastyaningrum, 2016; Rahmatin, 2013; Rohmatin, 2013; Syutharidho & M, 2015; Widodo, 2016; Yusmanto & Herman, 2015) and research that examines gender differences (Agustina & Amin, 2013; Fitriani et al., 2015; Irvaniyah & Oktaviana Akbar, 2014; Rahayuningsih & Feriyanto, 2018; Subarinah, 2013; Sukayasa, 2014). However, there are no studies that describe students' critical thinking skills in solving analytical geometry problems that are viewed from gender.

Based on previous research, the novelty of this study lies in the description of students' critical thinking skills in solving analytical geometry problems that are viewed from gender. So, this study aims to describe the profile of students' critical thinking in solving analytical geometry problems viewed from gender.

THE RESEARCH METHODS

This research is a qualitative study with a case study approach. The subject taking technique was done by purposive sampling. The subjects were taken as many as 2 male students and 2 female students. The main instrument in this study was the researcher and the auxiliary instruments were analytic geometry problem solving tests. The problem solving test consists of two stages, namely problem solving test I and problem solving test II.

Problem solving test I:

An ABC triangle is known with coordinates A (-1, -2), B (3, 1), and C (6, -5). Determine the coordinates of point D so that ABCD forms a parallelogram.

Problem solving test II:

A KLM triangle with coordinates K (-2, 3), L (1, -1), and M (7, 1) is known. Determine the point N coordinates so that the KLMN forms a parallelogram

The data collection technique uses think aloud and the validity test in this study uses time triangulation. Data analysis techniques used analysis from Miles and Huberman, namely data reduction, data presentation, and conclusion drawing.

THE RESULTS OF THE RESEARCH AND THE DISCUSSION

This study describes the students' critical thinking skills viewed from gender. In this study the profile of critical thinking in solving analytical geometry problems was identified through aloud thinking activities. Think aloud activities were recorded using a recording device, then transcriptions of think aloud activities were made, namely think aloud protocol based on the recordings obtained. Furthermore, field notes are made based on the current situation of the think-aloud activities. The transcription is reduced by identifying student questions and statements in the process of solving analytic geometry problems into intellectual standards of critical thinking, namely clarity, precision, accuracy, relevance, consistency, logical correctness, completeness, fairness (Bassham et al., 2010). But beforehand, transcription differentiated the stages of aloud thinking activities into four stages of problem solving namely

understanding the problem, devising a plan, carrying out a plan, and re-checking (Polya, 1973). Furthermore transcription that has been differentiated into categories and stages of problem solving is analyzed by means of data reduction, data display and conclusion drawing. Data analysis is also done by looking at the field notes and the results of student work to strengthen or support transcriptional data.

Data were analyzed using the analysis of Miles and Huberman, namely data reduction, data presentation, and conclusion drawing. After the data from the first and second collection results are obtained, the data is then grouped based on the stages of the problem solving process. Furthermore, the data at each stage are identified and grouped based on the intellectual standard of critical thinking being studied. In this study after the data has been reduced, data that has been grouped based on intellectual standards of critical thinking, then presented in the form of narrative texts and tables. From this presentation there will be seen a profile of critical thinking based on intellectual standards of critical thinking well in each subject of the study. The next step is to make conclusions and verification. Verification is done through scrutiny of critical thinking data in solving problems. Drawing conclusions is done by taking conclusions on data retrieval. This conclusion becomes a profile description of critical thinking in solving problems from each research subject.

Figure 1 shows the answer to the L1 subject (the first male student subject).

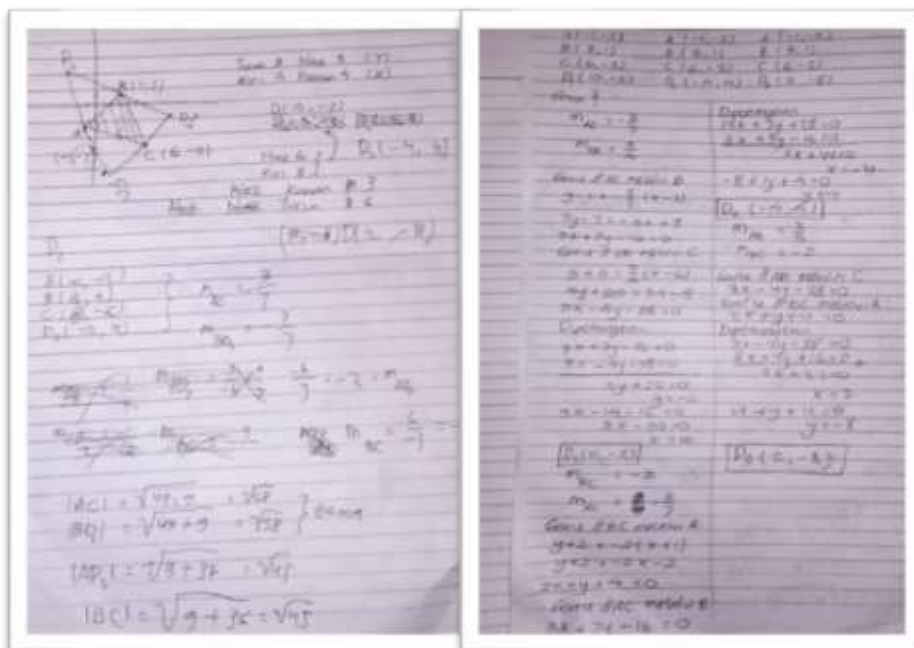


Figure 1. Answer of Problem Solving I from Subject L1

The following are the results of L1 subject interviews related to problem solving questions I.

W1-1105 P: "What information is there in the matter?"

W1-1106 L1: "An ABC triangle with coordinates A (-1, -2), B (3,1), and (C 6, -5) is required to determine the coordinates of point D so that the ABCD forms a parallelogram"

- W1-1107 P: "What does the question ask?"
- W1-1108 L1: "Finding the coordinates of point D so that ABCD forms a parallelogram"
- W1-1109 P: "Explain what is meant by the information you have mentioned earlier"
- W1-1110 L1: "Yes, by knowing the dots it was told to look for point D so that ABCD formed parallelogram"
- W1-1111 P: "What knowledge (what have you learned) is needed to solve the problem?"
- W1-1112 L1: "Knowledge of vectors, looking for line equation gradients, and parallelogram properties"
- W1-1113 P: "How is your strategy to solve the problem?"
- W1-1114 L1: "I use vector and straight line equation Sir"
- W1-1115 P: "Explain your reason why you chose that strategy to solve the problem!"
- W1-1116 L1: "Yes it's easier sir, heee"
- W1-1117 P: "The point is it is easier than what strategy?"
- W1-1118 L1: "From the equation of the straight line, Sir"
- W1-1119 P: "Now explain your steps to solve the problem!"
- W1-1120 L1: "Here, I draw first Sir, after that I look for point D it's up 3 right 4 units sir, so point D is found."
- W1-1121 P: "That's the vector strategy, isn't it?"
- W1-1122 L1: "Yes sir"
- W1-1123 P: "What is your underpinning theory using such a way?"
- W1-1124 L1: "Basically, it is the theory of understanding parallelogram, Sir"
- W1-1125 P: "What is it? Tell me more?"
- W1-1126 L1: "the opposite sides of Parallelogram are the same in length and parallel"
- W1-1127 P: "Where did you find the strategy? What material and what book?"
- W1-1128 L1: "I think it by myself, Sir"
- W1-1129 P: "Ok, what conclusions do you get from the results of implementing a strategy for solving the problem?"
- W1-1130 L1: "The point D that I found there are three, namely D1, D2, and D3 .It was the same way as looking for D1"
- W1-1131 P: "Are you sure that your work is completed and correct?"
- W1-1132 L1: "Insya Allah, I have, Sir"
- W1-1133 P: "Wait a minute, are there wrong steps or elements in your work?"
- W1-1134 L1: "Insya Allah, no Sir. I have already checked this using the line gradient and the distance between two points"?
- W1-1135 P: "How about the result?"
- W1-1136 L1: "The gradient of the sides are parallel and the length is the same, Sir."
- W1-1137 Q: "Is there a strategy or other way to solve the problem?"
- W1-1138 L1: "Yes, there is. Sir. I also use the equation of linear line."
- W1-1139 P: "Can you explain how it works?"
- W1-1140 L1: "Yes sir. first, find the gradient of AB, then through C is made a line parallel to AB."
- W1-1141 P: "How do I find the line equation?"
- W1-1142 L1: "By using the AB gradient and the point C coordinates can be made the equation of the line sir."
- W1-1143 P: "then"

W1-1144 L1: "Then through point B I make a line parallel to the AC and make the equation of the line in the same way as before, then look for the point of cut with the method of elimination and substitution"

W1-1145 P: "And it conveys the same as the first way"

W1-1146 L1: "Yes sir it is the same, point the coordinates of D1 are (10, -2)"

W1-1147 P: "Then what about point D2 and D3?"

W1-1148 L1: "The same way Sir. And the result is the same as well, Sir."

Figure 1 shows the answer to the P1 subject (the first female student subject).

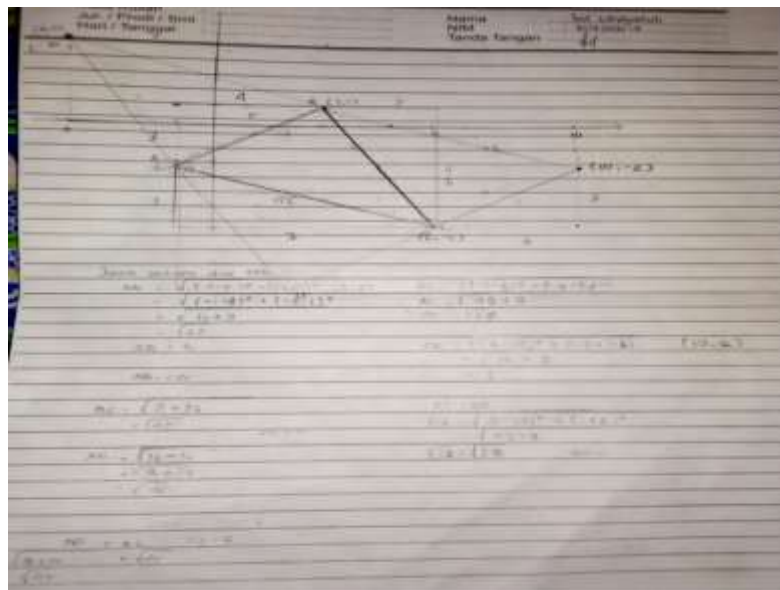


Figure 2. Answer of Problem Solving I from Subject P1

The following are the results of interviews with P1 subjects related to problem solving questions I.

W1-2107 P "Okay, I'm now going to interview you with some questions related to your work"

W1-2108 P1 "Yes sir"

W1-2109 P "First, what information is there in the matter?"

W1-2110 P1 "There is an ABC triangle with points A (-1, -2), B (3,1), C (6, -5)."

W1-2111P "What is the question asked?"

W1-2112 P1 "Determining the coordinates of point D until ABCD to form a parallelogram"

W1-2113 P "Explain what is meant by the information you have mentioned earlier"

W1-2114 P1 "It was known that these three points A, B, and C. Then, it was told to look for point D to form a parallelogram."

W1-2115 P "What theory (what have you learned) is needed to solve the problem?"

W1-2116 P1 "Coordinate system, parallelogram, looking for gradients of the equation of lines"

W1-2117 P "How do you / your strategy to solve the problem?"

W1-2118 P1 "I draw a line perpendicular from point C to right 4 and up 3"

W1-2119 P "What is your underlying theory to use that way?"

W1-2120 P1 "Since this is the parallelogram the opposite side is parallel and the same in length I take it by pulling from point A to point B. And from A to B up 3 to right 4"

- W1-2121 P "Okay, I continue the question Explain your reason why you choose that strategy to solve the problem?"
- W1-2122 P1 "Yes this is what I can, sir, ."
- W1-2123 P "Please, explain your steps to solve the problem now!"
- W1-2124 P1 "I draw a line of coordinates first, then I draw the dots to look for point D in the way I did .. I drag a perpendicular line from A to B. From A to B up 3 to the right 4 units then I made this as a guide to find point D. I drew a perpendicular line from point C upwards 3 units and to the right 4 units, and found point D (10, -2) Then I connected the points A, B, C, D so that forms a parallelogram"
- W1-2125 P "Where did you get the strategy? On what material and what source book?"
- W1-2126 P1 "Yes I just think by myself ,sir"
- W1-2127 P "What conclusions do you get from the results of implementing a strategy for solving the problem?"
- W1-2128 P1 "I found the coordinates of point D (10, -2) so that ABCD formed the parallelogram"
- W1-2129 P "Are you sure that your work is completed and correct?"
- W1-2130 P1 "Yes Sir, sure"
- W1-2131 P "If it is true that ABCD is a parallelogram, try to check whether the opposite side is the same in length and parallel."
- W1-2132 P1 "Oh yes sir, let me check it first" (subject checked quietly)
- W1-2133 P "have you finished checking it??"
- W1-2134 P1 "Yes, Sir"
- W1-2135 P "Yeah, how about ya?"
- W1-2136 P1 "I find the length of AB and the length of the CD by using the two-point distance formula. The result is both five. then the length of AC and BD I find it the same way and the result is the same in length, the root of 58, Sir "
- W1-2137 P "Then what about the parallel facing side each other? How to check the alignment?"
- W1-2138 P1 "The AB and the CD have the same slope Sir I made the perpendicular line to A to B up 3 units and to the right 4 units, so also from C to D."
- W1-2139 P "For AC and BC, is it also the same case"
- W1-2140 P1 "Yes sir, the same"
- W1-2141 P "Wait a minute, is there any wrong steps or elements in your work?"
- W1-2142 P1 "I do not think so sir, because I checked as I have just mentioned"
- W1-2143 P "Is there any other way or strategy to solve the problem?"
- W1-2144 P1 "Emmmm I Do not know sir, I usually do like this, heeee"
- W1-2145 P "Sure there's no other way?"
- W1-2146 P1 "no, Sir. No other way.

Table 1 contains a description of the profile of critical thinking of male and female students in solving analytic geometry problem.

Tabel 1. The Profile of Critical Thinking of Students in Solving Analytical Geometry

No	Intellectual Standards	Male Student Critical Thinking Profile	Female Student Critical Thinking Profile
1	Clarity	Male students read the problem at a glance (skimming). Male Students are able to convey what is known to the problem and what is asked clearly and correctly.	Female students read the problem at a glance (skimming). Female students are able to convey what is known to the problem and what is asked clearly and correctly
2	Precision	Male students are careful in planning a strategy or plan to solve the problems shown by understanding what is meant by the problem. Male students are also careful in implementing the plan to solve the problem. The Male student gives the reason for choosing his plan.	Female students are careful in planning strategies or plans to solve the problems demonstrated by understanding what is meant by the problem. Female students are less careful in implementing plans to solve problems. The female student does not give the reasons for the complete selection of the plan.
3	Accuracy	Male students understand the problem appropriately. In drawing up a plan the student can mention relevant prior knowledge to solve the problem. Male students are able to convey the steps of their strategy to solve the problem in general. In implementing the plan, the student tries to use his own thinking and mentions the source to obtain the strategy he implements.	The student understands the question exactly. In preparing a student plan link it with prior knowledge relevant to solving the problem. The student is able to convey the steps of his strategy to solve the problem in general. In implementing the plan, the student tries to use her own reasoning and mentions the source to get the strategy to be applied.
4	Relevance	Male students carry out plans in accordance with the plan has been prepared.	Female students carry out the plan as planned has been compiled.
5	Consistency	Male students feel there is an inconsistency in their belief that the answer is correct by checking the answer.	The female student felt there was an inconsistency in her belief that the answer was correct by double-checking the answer.
6	Logical correctness	Male students draw conclusions correctly through the process of implementing the plan and checking the truth.	Female student correctly through the process of implementing the plan and check the truth.
7	Completeness	Male students re-invent the work by checking the completeness and truth of the answer.	Female students re-dig the work by checking back the completeness and truth of the answer.
8	Fairness	Male students use alternative strategies to solve problems. Such alternative strategy as a means of correction of the strategy used previously.	Female students do not use alternative strategies to solve problems due to lack of knowledge about the strategy. Female students can only use one strategy only.

Based on the analysis of the results of the study, male students and female students met eight intellectual standards of critical thinking (Bassham et al., 2010). The results of this study also obtained information that the profile of critical thinking of male and female students in solving problems of analytical geometry was relatively the same for each intellectual standard of critical thinking. This is because there is no significant difference in mathematical critical thinking skills in terms of gender (Ika Wahyu Anita, 2015).

Differences in the profile of critical thinking of male students and female students in solving analytical geometry problems in this study lies in the intellectual standards of precision and fairness. In the intellectual standard of precision, male students are careful in giving reasons for making problem solving strategies. Whereas female students are not careful in giving reasons for taking the strategies used in problem solving. The results of the Sukayasa research state that they are better able to understand geometry concepts and are more critical and creative in developing ideas in solving problems than female students (Sukayasa, 2014). Based on the analysis of the results of the study, male students were able to provide reasons by considering two alternative strategies, which were more effective and efficient. This alternative difference in taking is what distinguishes male and female students from the intellectual standard of fairness. Female students only have one alternative solution. This is due to a lack of knowledge and experience of female students regarding these alternatives. Male students have a more open way of thinking, so that they are able to think abstract mathematically to bring up their novelty and flexibility by finding different patterns of answers and announcing the results they find carefully. While the subject of women has a way of thinking that is still in concrete experiments, and the difficulty of making abstract observations of abstract numbers so that patterns are generally not found. (Subarinah, 2013)

The results of this study are also relevant to Haryani's research which describes the profile of critical thinking processes of high school students in solving mathematical problems in terms of cognitive style and gender. The results of the study show that the thinking process of students in the four stages of problem solving fulfills aspects of clarity, accuracy, precision, relevance, logic, depth, breadth, and significance (Haryani, 2012). Male and female students can go through all stages of critical thinking in solving story problems. As well as the results of research by Rahayuningsih & Feriyanto which states that at the strategy planning stage, female students are more consistent in using concepts than male students. At the stage of implementing the plan, male students are better at using principles and writing symbols than female students. At the stage of checking again, female students are more systematic than male students. (Rahayuningsih & Feriyanto, 2018)

CONCLUSION AND SUGGESTION

Based on the results of analysis and discussion, it can be concluded that male students and female students have fulfilled eight intellectual standards of critical thinking in solving analytical geometry problems, namely clarity, precision, accuracy, relevance, consistency, logical correctness, completeness, and fairness. In the intellectual standard of precision, male students are more careful in giving reasons for taking problem-solving strategies than female students.

On the standard of fairness male students are able to provide two alternative problem-solving strategies, while female students only provide one alternative problem-solving strategy.

Suggestions that can be given to the next researcher are expected to be able to examine problems with a wider range and to be able to describe other abilities needed in mathematics, and lecturers should utilize intellectual standards of critical thinking in developing analytical geometry learning so students can solve problems better.

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