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Analysis critical thinking skills in solving problems algebra in terms of cognitive style and gender

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Abstract. Critical thinking is believed to have significant contributions to learners' academic context in the era progression of technology and information. Critical thinking skills are needed to solve problems, especially in solving algebraic problems. This critical thinking process is influenced by several factors including cognitive style and gender. The purpose of this study was to understand the process of critical thinking from the perspective of cognitive style and gender on solving algebraic problems students in the mathematics department at Walisongo State Islamic University. The kind of research qualitative descriptive, a test MFFT used to analyze cognitive style students into groups impulsive or reflective cognitive style. Tests to analyze skills critical thinking based on Ennis consisting of Focus, Reason, Inference, Situation, Clarity, and Overview. The research indicated that style cognitive and gender significantly affected the way and the ability to think critically students. This study provides information that on the subjects of reflective cognitive style, male are better than female in terms of critical thinking skills and there are differences in the process. Male subjects on reflective cognitive style are better than female subjects, but for the cognitive style exclusive female subjects are better than men.

1. Introduction

The ability of thinking and problem-solving skill has become the center of attention of educators, researchers, entrepreneurs, and media for several this years. These feelings are reflected in the fact that the ability critical thinking will determine endurance or competitiveness of a person in compete to be the stronger because it will increase the competitiveness of these individuals, in accordance opinions of researchers said skill up a critical thinking tool has been recognized as skill that is essential to ensure success for, work and live in the 21st century [1-3]. Someone having skills critical thinking high and the ability to communicate good will easily adjust changes in and valued both in the context of academic and the world of work [4-5].

Critical thinking involves the mental organized and participates in the process judge to solve the problems. Think critically can be seen from activities to analyze and interpret data in the scientific investigation. The Secretary's Commission on Achieving Necessary Skills in 1990 said that competence thinks critically, make a decision, solving the problem, and reason as something important in performance. In addition according to Johnson think critically is the ability essential that should be owned by good students in solving problems [6]. According to Ennis criteria or basic elements that should be owned by critical thinkers in solving problems is abbreviated to Focus, Reason, Inference, Situation, Clarity, and Overview that can be shortened by the term FRISCO [7-8]. Focus pertaining to



identification focus or main concern, Reason related to identification and assess acceptability reason, Inference pertaining to evaluate the quality of the conclusion, Assuming reason to acceptable, Situation pertaining to watch the situation carefully, Clarity, with regard to clearness, check to make sure its language clear and overview of pertaining to check back or a step back and look everything as a whole.

Critical thinking is capability will be vital for students, So think critically is one of activity must be maintained and taught in each subject, in the capabilities of a critical thinking tool is not inborn and not expanded naturally. So think critically is one of activity must be maintained and taught in each subject Because ability think critically not inborn and not expanded naturally. The ability to think critically is the potential intellectual that can be developed through the learning process, in accordance Schafersman think critically is a skill we should be teaching in students to prepare them to succeed in life and That was responsible for developing and teaches one of them are teachers, because some teachers have the flexibility to make learning planning [4], Arend stated that think critically be possessed by a student if students were consistently trained either through discussion directed and facilitated by an instructor [9]. The design learning made will be able to develop and teach critical thinking ability, when teachers in make it looked at the profile of critical thinking owned by students. To look at the profile of think critically students, researchers can see from activity students to solve the problem. In accordance with Ennis could be observed that there was a correlation between a critical thinking tool by means of resolving problems [10].

In solving the problem, students will use many technical strategies. Problem-solving strategies turned out to be much influenced by students' cognitive style, In accordance with statements from Alamolhodaei, the student with style cognitive different approach processing of information and solve problems mathematics in a different way [11]. So that differences will also trigger differences in their profiles critical thinking ability. A cognitive style that has been researched widely is impulsive or reflective [12]. A subject which has cognitive style impulsive faster in responding to the solution of the problems in a situation without careful thought, Consequently average them more do error while process information. On the subject of in the style of the cognitive reflective more inclined to put forward the prudence and provide an alternative form of before gave answers to a number of solutions, Hence they tend to make mistakes fewer when process information. However, the style of cognitive reflective or cognitive a style of impulsive is not linked to intelligence.

Related to the process of critical thinking, besides the difference style cognitive, gender differences also possible have leverage on the process reflect critical thinking. Leach and good in his research show gender and college affect ability average to think critically [13]. Research Rubin, who indicated the absence of a significant difference between men and female in the aspect of integers in general, although could be found certain aspects of the difference between the male and female to think critically [14]. In contrast to the research Myers [15] demonstrate that there are no significant differences in the capacity to think critical between students men and female. According to Rud and Baker gender not found a significant predictor score posttest ability to think critically [16]. This added evidence more to disputation the use of gender as the predictor of the ability think critically. Research Mitrevski [17] show memorizing facts and remember information did not develop critical thinking and practice laboratory is also not a right methods in terms of managing critical thought, this is shown from statistical analysis based on the pretest and posttest shows that a method of teaching practices laboratory ineffective develop critical thinking ability, by using t-test we did not find a significant difference between a men and a female. Gender and cognitive style are a component background need to be considered in the development of the ability of critical thinking. Generally, teachers/lecturer does not see those two factors, teachers /Lecturers still feel students the same ability in absorb lessons and solve problems algebra. Lecturers just saw of the score learning achievements without regard to the process. By it, all the more important the studies analyze the influence of factors gender and cognitive style on the ability to reflect critical college student.

2. Methods

The research uses a descriptive method with a qualitative approach. As for sample in research, this is the fourth semester students in the mathematics department at Walisongo State Islamic University in 2016. Data collection techniques that are undertaken in this research is done in two steps, namely data collection in style cognitive is carried out by providing test MFFT (Matching Familiar Figures Test) to group cognitive style students in stylish cognitive reflective (R) or the styles of cognitive impulsive (I) and instrument a test for measures the critical thinking. The subjects were selected by purposive sampling method, where the researcher determines the sampling by specifying specific characteristics that are in accordance with the research objectives. The results of the analysis of the tests of critical thinking skills that are given to all students, subjects can be communicate these ideas and representing style cognitive reflective and impulsive become special considerations in determining research subjects. Eight subjects were taken from 2 students with reflective cognitive style (RL), 2 students from reflective cognitive style (RP), 2 students with impulsive cognitive style (IL), and 2 students with cognitive impulsive style (IP) interviewed to deepen analysis of critical thinking skills that have been given through tests. Data analysis used to understand critical thinking skills is a method of data reduction, then triangulation is used for data validity.

3. Results and Discussion

Based on MFFT (Matching Familiar Figures Test) test results which requires students to choose a single picture identical with a picture standard as specified of six picture "very identic". A score based on the length of time needed before answering and the number of error resulting. Respondents with a short time and the high number of error will get "impulsive indicative", meanwhile the longer and the low number of error will get an indication to "reflective". Following the example of images used to a MFFT test;

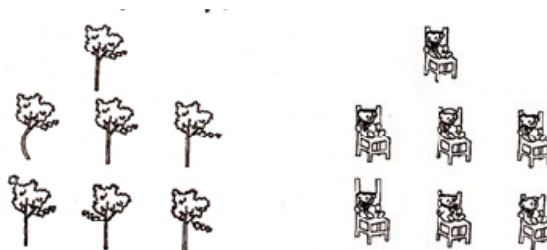


Figure 1. Sample of images used to a MFFT test

The population of research on fourth semester students in the mathematics department at Walisongo State Islamic University in 2016 consisting of three class, 120 students consisted of 35 male undergraduates and 85 female undergraduates in lecture algebra linear, can be classified into four different criteria that is the subject of 23 male with style cognitive reflective (RL), 54 female cognitive reflective (RP), 12 male to the style of cognitive impulsive (IL) and 21 female to the style of cognitive impulsive (IP). Furthermore, given a critical thinking ability test to the entire study population, and the interview process on the research subjects. MFFT set are the instruments are reliable in categorizes reflective- impulsive [12, 18, 1, 19, 10, 20]. Some research shows that gender is one of the factors affecting an ability [21].

Critical thinking analyzed by using the criteria which were conveyed by Ennis a person who thinks critically also ideally had certain criteria or basic element cut down with FRISCO (Focus, Reason, Inference, Situation, Clarity, and Overview) [8]. At a step focus college student capable of analyze about question to be able to record that known, asked in the form of algebra and capable of plan concepts anything to be used in solve the problem, criteria reason college student can give reason based on fact or evidence of data, definition, axioms, lemma, theorem relevant with every step planned in plan on the focus criteria, Inference criteria college student can make inferences properly and able to provide or choose a good reason to support conclusions made by using data, definition, axioms,

lemma, theorem relevant (factoring concept, substitution, equivalence equation) the Situation criteria college student to use all information based on the data, definition, axioms, lemma, theorem, or forms representation other relevant or in accordance with problems, Clarity criteria that is were able to declare the reasoning, justifies or clarify reasoning according to taking into account evidence, the concept, methodology, criteria and the context; and presenting reasoning within forms of argument are valid and convincing. And criteria overview of the check the of each step that have been undertaken based on data, definition, axioms, lemma, theorem, or forms representation other relevant. Sample questions used can be seen in figure 2 below;

A leaflet letter contain 50 square meters of printed material. The print-free path is top and below 4 cm wide and on the left and right side is 2 cm wide.

What is the size of the leaflet letter, so it requires paper to a minimum?

Figure 2. Sample questions to measure critical thinking skills

Based on process triangulation of written tests and an interview, critical thinking ability of each subject outlined as follows;

Table 1. The results of the analysis data the ability critical thinking high criteria in solving problems in terms of style cognitive and gender

Ability Critical Thinking		Reflective Men (RL)	Reflective Female (RP)	Impulsive Men (IL)	Impulsive Female (IP)
Focus	Analyze about question to be able to record that known, asked in the form of algebra	√	√	√	√
	Capable of plan concepts anything to be used in solve the problem	√	√	√	√
reason	Give reason based on fact / evidence or data , definition , axioms , lemma , theorema relevant with every step planned in plan on the focus criteria	√	√	√	√
Inference	Can make inferences properly by using data , definition , axioms , lemma , theorema relevant (pemfaktoran concept, subtitusi, equivalence equation)	√	√	less able	less able
	Able to provide or choose a good reason to support conclusions made by using data , definition , axioms , lemma , theorema relevant (pemfaktoran concept, subtitusi, equivalence equation)	√	√	less able	less able
Situation	Use all information based on the data, definition, axioms, lemma, theorema, or forms representation other relevant or in accordance with problems	√	less able	less able	less able
Clarity	Justifies or clarify reasoning according to taking into account evidence , the concept , methodology , criteria and the context;	less able	less able	less able	less able
	Presenting reasoning within forms of argument are valid and convincing	less able	less able	-	-
overview	Check again the of each step that have been undertaken based on data, definition, axioms, lemma, theorema, or forms representation other relevant	less able	-	-	-

Information; √ = Able criteria = 85% qualify; Less able = 45% - 84% qualify; - = Incompetence criteria = 0% - 44% qualify

Based on table the results of the analysis the ability critical thinking high criteria at the top for the subject of RL, RP, IL and IP capable of analyze questions so that it can be identified that there problems and understand questions and able to create a plan concepts whatever will be used in solving problems, this capacity can be seen from the ability to record that known and asked the properly and effective in the form of algebraic equation, Subject capable of tell information back which is found in about matter algebra by using his own words but there are certain words that still adopt of question res. In the planning and decision-making stage, female students wrote down the calculations in detail but took longer to understand the questions. In contrast to male students who wrote succinctly and took a moment to understand the question. Based on the observations of these stages, male students do not really like writing, so male students only wrote what was considered important. While performing calculations, they were not always written, only the calculations that were considered important were written. This is in line with NAPLAN (National Assessment Program-Literacy and Numeracy) proposed that men regularly beat female in numeracy, and girls consistently beat boys in reading, writing, spelling, and grammar [22]. In addition to writing, men are more likely to use logic when working on equation algebra problems, where the questions are not routine /conventional. This is in line with the results of Gallager that male students are more likely to work correctly in solving nonconventional problems using logical or logical estimation and understanding [23]. Because of the two things above, so men tend to make interpretations in the form of sketches or drawings.

The subject RL, RP, IL and IP of capable of giving reasons for based on fact/evidence or data, the definition of, axioms, lemma, theorem relevant with each step planned in the plan on focus criteria. The time it takes the subject female relative longer than on the subject of male in giving reasons for on each the decision they have taken, Cognitive style reflective in giving reasons for more effective, minutely, right, has had several an alternative form of answer more and takes longer than impulsive cognitive style. The impulsive cognitive style which is relatively more long-time that occasionally made a mistake but still are considered relevant. Cognitive style impulsive occasionally made a mistake but still are considered relevant. This is in line with Kagan and Kogan say the boy impulsive said quickly and gotten a lot wrong than the reflective in quality inductive reasoning [24].

The subject of male and female able to draw any conclusions, use factoring concepts, substitute, the equation for equality in giving reasons to support the conclusions. But based on style cognitive, style cognitive reflective better than style cognitive impulsive, Because it provides an explanation why draw conclusion pertaining to the question, the subject of cognitive style impulsive do the few errors so that is categorized as a who less able to take a conclusion that in accordance. Subject male to the style of cognitive reflective capable of using all information based on the data, definition, axioms, lemma, a theorem, or form representation other relevant to solve the problems, But on the subjects of female in the style of the cognitive reflective, the subject of male in the style of the cognitive impulsive and the subject female in the style of the cognitive impulsive is in the category of who less able to use all appropriate information because we have done the few errors in some about trying to settle the case. The subject of male and female in the style of the cognitive reflective and impulsive they less were able to declare the outcomes of the reasoning or presenting reasoning in the form of argument So subjects could not distinguish between conclusion grounded in logic valid. The subject of cognitive male reflective unclear and less logically in evaluating or check back conclusion gathered in to solve the problem. The subject of female in the style of cognitive reflective, the subject of male and female with the cognitive impulsive not a evaluate or check back conclusion gathered in to solve the problem. The subject of male either on cognitive reflective and critical thinking ability impulsive have scored better than in female. The outcome of the findings has been in line with research conducted by Leach and Good indicates the type of genital and college main significantly affect the average capability may reflect critical thinking [13].

4. Conclusion

Research that is done get some findings cognitive style and gender in significant to affect the ability critical thinking students and obtained the difference the process may critical thinking at a high rate in

solving the problem of algebra. Analysis undertaken classify student to be four groups, namely the subject a male with reflective cognitive style, the subject of female in the style of the reflective cognitive, the subject of a male with impulsive cognitive style , and the subject female by impulsive cognitive style.

From the analysis obtained differences in the process of critical thinking high levels of each group subject, But all group of students is able to analyze about that can put known, asked and formulate in the form of algebra and develop concept concerned; Capable of create a plan by using definition, lemma, a theorem well for use in solving problems; They can clarify or give reason to concepts written in planning solve the problems logically. Of subjects with a reflective cognitive style capable of making a conclusion by right and give or choose a good excuse to support conclusion using data, the definition of, axioms, lemma, a theorem relevant factoring (concept, substitute, the equation of equivalence), But on the subjects of impulsive cognitive style is categorized as a less well-off in these things; Only the subject of male in the reflective cognitive style that able to use all information based on the data , the definition of , of an axiom , lemma , a theorem , or form of a representation or in accordance with another problem that is relevant to their needs, while third the subject matter of the other is categorized as a is less able in of these performance indicators. The four subjects less were able to declare the outcomes of the reasoning or presenting reasoning within forms of argument valid and in indicator justifies or clarify the reason in accordance with consider evidence , the concept of , methodology , the criteria and the context. The subject of a male with reflective cognitive style and the subject female in the cognitive impulsive style is in the category of less well-off, the other two groups that including category not capable. Fourth subject neither one is capable of checking again the each step that have been undertaken based on data, definition, axioms, lemma, theorem for forms representation other relevant.

Based on the results of the analysis so lecturers or teachers in efforts to improve the ability critical thinking then must consider differences in style cognitive and gender. Although men and female have different characteristics, teachers have to give students a chance and impulses that same in learning. From the results of research increase in the process of students ability to check back in every step taken in the process problem solving valid and logical worthy of being a focus on learning his campaign to improve the ability to think critically. The ability of critical thinking can be improved through problems based on learning that consistently and structured trained through a discussion directed.

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