The profile of critical thinking and learning outcomes of teacher candidates viewed from gender differences

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Abstract. This research is intended to determine the profile of students’ critical thinking viewed from gender differences and whether there is a correlation between critical thinking and learning outcomes of basic mathematic. This research is a descriptive quantitative design in which 40 Biology teacher candidates as samples. Data collection is conducted through tests. The results showed that: 1) The average level of male student’s critical thinking (53.78) is higher than female’s (52.61), 2) At the high critical thinking level, it was found that (male = 63.25, female = 61.22), in the moderate level: (male = 53, female = 52.15) and in the low level (male = 42.5, female = 42), 3) The highest aspect of critical thinking is assessing credibility (4.28), and the lowest one is producing arguments (3.74), 4) The average level of male student’s learning outcome (70) is higher than female’s (60.68), 5) There is a significant correlation between students’ critical thinking and their learning outcomes. It can be concluded that male students are more critical than female’s and there is a correlation between critical thinking and learning outcomes. Therefore, students are suggested to practice their critical thinking ability.

1. Introduction

The aim of Learning is an activity that learners do the learning process. Learning is a behavior changing that lasts a long time, or behavioral abilities using certain methods from the results of other practices or experiences [1]. Thus, Learning is not just memorizing, students must construct knowledge on themselves [2]. The process of constructing knowledge is a learning framework. However, Learning framework consists of 1) previous knowledge both absorb and conceptual and 2) the nature and structuring of new information [3].

Learning is a change in behavior by constructing knowledge and interaction with the environment through practice or experience, and the results obtained from that knowledge construction are usually called learning outcomes. The objectives and learning outcomes are expressed in the form of behavior, which includes cognitive, affective and psychomotor aspects, which are divided into learning taxonomies. However, the classic Bloom taxonomy revised by Anderson and Krathwohl combines knowledge in the learning process into: at first, dimensions of creating knowledge (facts, concepts, procedures and metacognitive) and the second one is dimensions of cognitive processes (memory, knowledge, application, analysis, evaluation and creation) [4].

Gender differences are basic characteristics that inherent in. This difference does not mean that one is superior to another or vice versa, but with these differences they complete each other. Men act out of women in spatial tasks, and women outnumber men in verbal and reading skills at the beginning -
the beginning their lives [6]. Actually, the differences between men and women include: 1) differences in the physical. Male usually have physically bigger and stronger, 2) boys usually superior in spatial skills (science and mathematics), while women are more superior in verbal skills (arts and music), 3) male students tend to be more aggressive than women [7]. Thinking distinguishes human activity and distinguishes it from other creatures. Whereas thinking activities involve all human, their feelings and desires. Thinking is a mental process that is carried out consciously to solve problems, make decisions, or gain understanding [8]. Thinking is the activity of the soul that lay the connection of some of knowledge we have [9]. Therefore, thinking is a mental activity that puts the relationship of some knowledge to solve problems, make decisions and finally get understanding.

The strategy to lead the thinking process in solving the problem can done through the following ways: 1) the comprehensive strategy is to solve the problem by facing the problem comprehensively, 2) the detailed strategy is to solve the problem part by part [10]. Thinking distinguished into three categories those are: reflective, creative, and critical thinking [8]. Reflective thinking understands proces of problems, researching or extracting information and solving [11]. By doing critical thinking, it is enabling us to have a better understanding of the ideas, data, arguments and situations. Creative thinking able to spark ideas and help us do more than rational possibilities based on our knowledge [11]. Critical thinking is very necessary in the learning process. Students learn to use their thinking skills to analyze problems and solve them. However, critical thinking is the application of careful reasons in determining whether the claim is true and reasonable [12]. Critical thinking is a process of thinking based on rational and reasonable thoughts and beliefs. The reason presented serves to test whether the argument is good in quality or not through investigation. The purpose of critical thinking is solving the problem by using the correct beliefs and thoughts and make sense, but it does not aim to break the people and favor the arguments themselves.

In case to find out whether someone has critical thinking, we can see from critical aspects. The basic aspects of developing critical thinking include claims, problems, and arguments [12]. The basic activities in critical thinking are investigation, interpretation and judgment. Investigation is finding evidence or data that will answer questions about a problem, interpreting is find out the meaning of the evidence and judging is obtaining the conclusion of a problem [8]. Essentially, critical thinking aspect include: 1) identify the elements in the case of thought (reason and conclusion), 2) identify and evaluate assumptions, 3) clarify and interpret statements and ideas, 4) assess the acceptance (credibility and claim), 5) evaluate various arguments, 6) analyze, evaluate and produce explanations, 7) analyze, evaluate and make decisions, 8) draw conclusions and produce arguments [13]. The indicators used in compiling a critical thinking test adopted from Fisher's.

2. Methods
Nevertheless, this study uses descriptive quantitative methods, the population and the sample approximately are about 40 Biology education UM Metro. Profiles are expressed in descriptive form. However, linear regression analysis is the way to find out critical thinking relationships (independent variables) and learning outcomes (dependent variables). Critical thinking data and learning outcomes are obtained from tests on basic mathematics courses.

3. Results and Discussion
3.1. Critical thinking profile and learning outcomes
The critical thinking profile and learning outcomes obtained based on descriptive analysis presented in the following Table 1.

| Critical thinking | Male Count (%) | Average | Female Count (%) | Average | Total Count (%) | Average |
|-------------------|---------------|---------|------------------|---------|----------------|---------|
| High              | 4 (44,44)     | 63,25   | 9 (29,03)        | 61,22   | 13 (32,5)      | 61,85   |
| Medium            | 1 (11,11)     | 53      | 13 (41,94)       | 52,15   | 14 (35)        | 52,21   |
Table 2. Recapitulation of Value Aspects of student critical thinking

| No. | Indicator thinking                | Number of questions | Question number | (%)  | Average |
|-----|-----------------------------------|---------------------|-----------------|------|---------|
| 1   | Identify reasons and conclusions  | 1                   | 7,692307692     | 4.25 |         |
| 2   | Evaluating assumptions            | 2                   | 15,38461538     | 4.06 |         |
| 3   | Interpret statements              | 2                   | 15,38461538     | 4.09 |         |
| 4   | Judge credibility                 | 1                   | 7,692307692     | 4.28 |         |
| 5   | Evaluate arguments                | 2                   | 15,38461538     | 3.74 |         |
| 6   | Draw a conclusion                 | 2                   | 15,38461538     | 4.24 |         |
| Total|                                  |                     | 13              | 100  | 52.875  |

Table 3. Recapitulation of the Value of Basic Mathematics Learning Outcomes

| Learning outcomes | Male | Female | Total |
|-------------------|------|--------|-------|
|                   | Count (%) | Average | Count (%) | Average | Count (%) | Average |
| High              | 1    | 11.11  | 12    | 38.71  | 13    | 32.5  | 78.69 |
| Medium            | 2    | 22.22  | 12    | 38.71  | 14    | 35    | 61.29 |
| Low               | 6    | 66.67  | 12    | 22.58  | 13    | 32.5  | 48.46 |
|                   | 9    | 100    | 31    | 100    | 40    | 100   | 62.78 |
| Max               | 100  | 90     | 100   |        | 100   |       |      |
| Min               | 40   | 40     | 40    |        | 40    |       |      |

3.2. Description of table

The mean level of student critical thinking in men (53.78) and women (52.61). The average value of male critical thinking is higher than that of women, but the highest value is equal to the same as while the lowest value of male students (equal to 36) is lower than women (by 37). For data overall highest score = 75 and lowest value = 36. At the critical thinking level students who have a high category (male = 63.25, female = 61.22), moderate category (male = 53, female = 52.15) and low category (male = 42.5, female = 42.3). In each category, the value of male critical thinking is higher than that of women. In the overall data obtained the average critical thinking in the high category = 61.85, the medium category = 52.21 and the low category = 42.39.

The highest average aspect of critical thinking of students is judging credibility (amounting to 4.28), and the lowest is generating arguments (3.74). The criteria for the value of each aspect are in the medium category. The student learning outcomes average in men (70) and women (60.68). The overall data average = 62.78. The average value of male learning outcomes is higher than that of women. The highest value of male students (= 100) is higher than the highest value for women (= 90), the lowest value of male and female students is equal, namely = 40. On teach outcomes students who have a high category (male = 78.3, female = 79), moderate category (male = 60, female = 61.5) and low (male = 40, female = 49.17). In each category, the value of male learning outcomes is lower than that of women. To determine whether there is influence of critical thinking with the learning outcomes regression test as follows:
3.3. Influence  
Test Criteria: Accept H0 if the value is Sig. > 0.05.  

**Table 4. Recapitulation of the Value of Basic Mathematics Learning Outcomes**

| Model      | Sum of Squares | df   | Mean Square | F     | Sig. |
|------------|----------------|------|-------------|-------|------|
| 1 Regression | 2372,967       | 1    | 2372,967    | 16,692| .000 |
| Residual   | 5402,008       | 38   | 142,158     |       |      |
| Total      | 7774,975       | 39   |             |       |      |

1) Predictors: (Constant), B_Critics,  2) Dependent Variable: Has learning

It can be seen that the value of Sig. = 0.000 which is less than 0.05 to reject H 0 and accept H 1. The conclusion is: Critical Thinking Ability has a significant influence on Learning Outcomes.

3.4. Coefficient of Determination (R Square)  
The magnitude of the influence of critical thinking on learning outcomes can be seen in the percentage.  

**Table 5. The results of the analysis test the magnitude of the influence of critical thinking and learning outcomes**

| Model Summary b | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|-----------------|---|----------|-------------------|---------------------------|
| 1               | .552 a | .305     | .287              | 11,923                    |

a. Predictors: (Constant), Critical thinking
b. Dependent Variable: Learning outcome

In the R Square column, the value is 0.305 or 30.5%. This shows that critical thinking has an effect of 30.5% on learning outcomes.

3.5 Regression Model  
Regression models can be used to predict learning outcomes (Y) if known critical thinking (X), namely:  

Y = 22,114 + 0.788X  

**Table 6. The results of the test analysis are linear regression models**

| Coefficients a | Unstandardized Coefficients | Standardized Coefficients | t | Sig. |
|----------------|----------------------------|---------------------------|---|-----|
| Model          | B                  | Std. Error | Beta       |    |     |
| 1(constant)    | 22.114             | 10.129      |            | 2.183 | .35 |
| Critical Thinking | .788              | .193        | .552       | 4.086 | .000 |

a. Dependent variable: Learning outcome

The critical thinking ability of male biology teacher candidates is higher than female in the high, medium or low categories. The learning value of male students is lower than for women in all categories. Male students are more critical than women, seen when learning activities take place, they ask more questions and answer questions. This is consistent with the opinion of Arends in Rasiman (2015) which states that I men and women have different cognitive abilities, I men are more rational have enthusiasm for things that are logical, abstract, so they are better at logical thinking and more critical. Meanwhile, women are more accurate and careful in making decisions; their memories are better, more emotional, and more interested in verbal skills.

Siswati (2016) states that the average value of male students' men were metacognitive skills (by 33, 54) is higher than female students (by 33.38) [14]. Metacognitive ability is the process of controlling thinking to solve problems. Syarifah et al. (2016) revealed that the percentage of metacognitive skills
in male students experienced a higher increase than female students, although the average female students were higher than. This is in line with the results of the study of Siswati et al. (2016) that the mean results of understanding the concept of male students (by 44.49) were lower than female students (by 44.79) [15]. Devine et al. (2012) revealed that girls may have the potential to perform better than boys in mathematics may, but their performance may be weakened by their higher levels of mathematical anxiety.

However, the learning outcomes obtained by male students are lower than those women are. Problem solving for male students tend to be less thorough female where they do not re-examine their work. Whereas women are more careful, and they double-check their answers. The Differences of men and women are seen in their high critical abilities. Rasiman (2015) revealed that female students capable of solving mathematical problems carefully and correctly, while the boys were able to resolve the issue properly but less cautious and did not check the results of his work.

Mathematics materials discuss many questions that require problem solving and proof. Mathematics is a means of knowledge and a means of deductive reasoning. Deductive thinking patterns are widely used both in the scientific field and in other fields, which are, conclusions that are based on the premises whose truth has been determined. Whereas the proof in mathematics, includes explaining, investigating, making guesses, based on definitions, reasons and making conclusions [16]. Problem solving and proof in mathematics requires critical thinking skills. Critical thinking is the process by which we examine arguments and determine which arguments are of quality and which are not, through the search for answers using inquiry questions[8].

The highest average aspect of critical thinking of students is judging credibility (amounting to 4.28), and the lowest is producing arguments (3.74). The important things that must be considered in assessing credibility are: 1) the source to be assessed, 2) the context that affects its credibility, 3) justification from the source that will affect the claim, 4) the nature of the claims made and 5) other evidence that strengthens [13]. The lowest value of critical thinking aspects is to produce arguments and overall critical thinking of students in the medium category. One of the criteria for a good critical thinker is m able to present back thoughts and arguments in a better form. When learning about critical thinking skills students gain more knowledge through thinking, reasoning, and fact-based questions and learning "what to think" through "how to think" and assessing the effectiveness of arguments through reflective thinking. In this way, students can obtain the skills needed in critical thinking to enable them to solve personal, community and national problems [17].

Based on calculations using the linear regression result that, H0 if the value is Sig. > 0.05, meaning critical thinking has a significant influence on the results of basic mathematics learning. The magnitude of the influence of critical thinking on learning outcomes is 30.5% and 69.5% is influenced by other factors, with the regression equation Y = 22.114 + 0.788X . The study result are consistent with the research of Ikman et al (2016) mathematically critical thinking skills of students increased after using the learning problem based learning [18]. Student learning outcomes increase significantly where teachers can develop professional abilities related to teaching critical thinking skills [17]. OIDDE learning model has improved students' high level thinking skills [19]. Critical thinking correlates significantly with learning outcomes, namely in the aspects of conclusions, recognition of assumptions, deductions, evaluation of arguments and total critical thinking scores [20].

Critical thinking skills help students in solving learning problems and problems in everyday life. In solving problems, they explain, investigate, explore and evaluate information logically and make sense. The students who have critical thinking skills to build knowledge that is beneficial to their lives; thus, they can increase their motivation in solving problems [21]. However, there is no relationship between mathematical critical thinking skills and curiosity after using problem-based learning and cognitive conflict strategies [22].
4. Conclusion
Based on the discussion above, we can conclude the results of this study. Those are: Male students are more critical than female students. The results of basic mathematics learning for male students are lower than female students on learning outcomes. There is a linear effect of the level of critical thinking on learning outcomes by 30.5%. Finally, the suggestions can be given is that students should practice improving their critical thinking skills. The teachers can use this selecting learning strategy according to their characteristics and critical thinking students. As the result, their learning outcomes increasing.

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