Profile of students' creative thinking in solving mathematics problems in terms of gender

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Abstract. This study aims to describe the creative thinking process of students in solving math problems in terms of differences in gender. This study qualitatively examines the creative thinking process of sixth semester students of mathematics education at the Faculty of Science and Technology, UIN Walisongo. The data collection techniques used in this study were questionnaires, tests, interviews and completed with documentation. The data analysis techniques in this research are data reduction. The data analysis technique in this research is data reduction and data validity by using time triangulation, namely by looking for the suitability of interview data which originates from the problem of two similar questions. The results showed that gender differences did not significantly affect students' creative thinking abilities. Male subjects need stimulation of questions from researchers to compile information correctly and precisely. Male and female subjects monitored the problem-solving process well, but both had not yet carried out an evaluation process.

Keywords: creative thinking, Solving Mathematics Problems, Gender

1. Introduction

In the industrial era 4.0, The state will exist when it is able to move quickly to respond to adaptation demands, looking for new alternatives in solving problems to anticipate technological developments. The ability to solve problems and the ability to think logically (critical, creative) are abilities that must be possessed by human resources (human resources) in developing countries such as Indonesia in the industrial era 4.0. According to Munandar's opinion [1], Indonesia as a developing country needs human resources who are critical, creative and able to adapt to changes caused by rapid technological developments, so that they can make meaningful contributions to science and technology and the country's society. In addition, Munandar [1] also revealed reasons for the importance of creative thinking, namely through the ability to think creatively a person will be able to actualize himself, humans will be able to improve their quality of life if they have the ability to think creatively, and someone can see various possibilities for solving problems if they have the ability to think good creative. This is also in accordance with the opinion of several other researchers who state that thinking skills have been recognized as essential skills for successful learning, work and life in the 21st century [2-4]. A person who has high creative thinking skills and good communication skills will easily adapt to changing conditions and is respected in both the academic context and the world of work [5]. The ability to think creatively is able to encourage someone to be skilled at solving problems and finding...
various alternative solutions according to the opinion of Lambertus [6] which states that through creative thinking our thinking processes will be trained to pay attention to intuition, turn on the imagination, reveal new possibilities, and develop unexpected ideas.

In the realm of education, creative thinking is an important ability for students, so creative thinking must be an activity that is developed and taught in every subject, because the ability to think creatively is not innate and does not develop naturally. The ability to think creatively is an intellectual potential that can be developed through the learning process, according to Schafermans [7]. Critical and creative thinking are skills that must be taught to students through the natural sciences or other disciplines to prepare them for success in life.

The teacher or lecturer is an individual who is responsible for developing and teaching students' critical, creative, problem-solving abilities because the teacher has the flexibility to make lesson plans before the learning process is carried out. This is in accordance with the opinion of Arend [8] which states that critical thinking, creative thinking, problem solving can be owned by a student if the student is consistently trained either through directed discussion or facilitated by an instructor. To create appropriate learning designs in developing and teaching creative thinking, one of the things the teacher can do is pay attention to students' creative thinking profiles and get used to solving problems. This is so that every mathematics learning that is carried out always pays attention to students' creative thinking abilities. To see the creative thinking profile of students, researchers can see from student activities in solving problems. This is in accordance with the opinion expressed by Ennis [9] which can be concluded that there is a relationship between thinking and problem solving. Other researchers [10] revealed that one way that can encourage creative thinking skills in learning mathematics is to get used to solving problems.

In creative thinking, there are key components, namely fluency, flexibility, novelty [11-13]. Other researchers reveal that fluency, flexibility, originality, and elaboration are components of mathematical creative thinking. Each component can be observed through the student problem solving process. According to Munandar's opinion [15], all components of creative thinking: fluency, flexibility, originality, and elaboration can be observed in the problem solving process. Students will use various strategies in solving problems. Problem solving strategies are influenced by many factors, one of which is gender. Experts generally agree that learning outcomes caused by gender differences are the result of gender bias in the home and school environment [14]. First, although many cultures apply and have specific rules, experts generally agree that there is a tendency towards the same behavior between men and women in the United States [15]. Result research shows that in general, parents have a greater expectation of boys to succeed in math and science than their daughters. Parents believe that boys perform better than girls in math and science [16]. In textbooks there is a gender bias, men are more often used as models in textbooks than women [17], and female peers who are skilled or have abilities in math and science tend to be laughed at or other peer taunts. Teachers may also have complex expectations with regard to student gender. Leach and Good [18] in their research show gender and large universities have a significant effect on the average creative thinking ability. This adds more evidence to the debate over the use of gender as a predictor of creative thinking abilities.

Creative thinking is needed in studying abstract mathematics. Especially in courses that enter the realm of analysis such as algebraic structures, requiring students to think critically and creatively in correlating previous definitions, theorems or lemmas in writing several alternative proofs of a new theorem. In the algebraic structure course in Mathematics at UIN Walisogo, on average, students have difficulty learning it. The difficulty of these students is shown by the lack of students' ability to explore supporting theorems in proof so that they are less confident about the results of their answers, Students have not been able to find several alternative methods in answering the questions or there has been no significant effort from students to explore several alternative evidence that are different from those exemplified by the teacher. students only memorize the theorem without understanding the concept so it is difficult to apply it. From these conditions it can be assumed that students' creative
thinking abilities are still low and this condition causes learning outcomes of algebra to be relatively low.

The learning outcome data shows an indication of differences in the thinking abilities of male students and female students. So it is necessary to improve learning strategies and planning to improve students' creative thinking skills. To create a suitable learning design in developing and teaching creative thinking, one of the things the teacher can do is to look at the student's creative thinking profile. As a planning optimization step, research is needed to identify students' creative thinking processes in terms of cognitive style and gender. So that the purpose of this study is to describe the creative thinking profile of the mathematics education study program students of UIN Walisongo in solving problems in terms of gender.

2. Methodology
This research is classified as a qualitative exploratory research carried out in the subject of the algebraic structure of the sixth semester students of the mathematics education study program at UIN Walisongo Semarang in the 2019/2020 academic year. The instrument in this study was a test of creative thinking skills. The test, interview and documentation methods were used to collect data and capture all important things that were done during the research so that all activities could be recorded properly. Data reduction is used to analyze test and interview data in the context of presenting data and drawing conclusions / verification. Validity by using time triangulation, namely by looking for the suitability of interview data which originates from the problem of two similar questions. Selection of research subjects based on the consideration of students who are able to communicate the results of their work. The three main elements of creative thinking in this study, namely fluency, flexibility, and originality, are observed through a problem-solving cycle consisting of problem identification, problem boundary determination, strategy development, information organization, resource allocation, monitoring, evaluation.

3. Results and Discussion
This research was conducted on the subject of algebraic structure in the 6th semester students of mathematics education in the 2019/2020 school year of the Faculty of Science and Technology, UIN Walisongo Semarang Indonesia. The class consists of 28 students with descriptions of 17 female students and 11 male students. The creative thinking test instrument was validated by 3 validator math education experts with an average score of 3.6 on a scale of 4 so that the test kit was declared fit for use with a little revision.

Based on the analysis through the triangulation of interview data, it was found that there was no significant difference between male students' creative thinking abilities and female students although there were differences in the process of solving problems. Creative thinking process in solving algebraic problems in male students (SKL) and female students (SKP), can be explained as follows; On the aspect of fluency, SKL and SKP are able to convey clearly that there are problems that need to be resolved in the information provided, write correctly and completely the information that is known and asked. The two subjects fluent in expressing definitions, lemmas and arguments that support the complete completion process and formulating appropriate resolution strategies after being given stimulus questions from researchers. SKL and SKP subjects were able to interpret the problems in the questions into algebraic equations correctly, but male subjects needed a stimulus for questions from researchers. Both subjects are not fluent in implementing the process completion strategy which is marked by incomplete answers but the steps taken are correct and Unable to predict the time it will take to solve a problem correctly. The subject has not been able to ascertain every step taken in the implementation of problem solving according to planning (monitoring). SKP has not carried out the evaluation process properly because it only re-reads what has been done. On the aspect of flexibility; The subject has not been able to provide different alternative strategies to solve the given problem so that the flexibility of the subject is still low. On the aspect of originality;
On the aspect of originality; The novelty of the process of solving the subject's problem is seen when the subject is able to sketch the problem into a picture and form algebraic equations that appear even though they are not able to solve the problem completely. The following is an example of a summary process of interview results to help assess the validity of the data through the triangulation process; Summary of interview transcripts to determine the boundaries of the problem which consists of two indicators, shown in the Table 1.

Tabel 1. Summary of interview transcripts to determine the boundaries of the problem which consists of two indicators

| Indicator                              | Interview summary, question number 1                                                                 | Interview summary, question number 2                                                                 |
|----------------------------------------|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| Identify facts/information about the   | yes sir, in my opinion from the information on question number 1 it is known, there is a rectangular| yes sir, in my opinion the information in question number 2 is, a leaflet contains 50 square centimeters of printed material and free printable paths above 4 cm and on the right and left 2 cm each. (the information disclosed is incomplete) |
| problem clearly and logically          | cardboard with a width of 5 dm and a length of 8 dm which is planned to be made a box without a lid. (the information disclosed is incomplete) | (After the subject received a stimulus question from the researcher) sorry sir, there is something missing, a leaflet containing 50 cm square of printed material. The print-free path above and below is 4 cm wide and on the left and right sides 2 cm wide. |
| formulate the problem correctly       | - (After the subject received a stimulus question from the researcher) sorry sir, there is a rectangular cardboard sheet with a width of 5 dm and a length of 8 dm to make a box without a cover. On the four corners of the cardboard cut out a square with sides x dm. | - letter paper sizes that can be made, from the paper provided. |
|                                        | - the volume of buildable blocks, sir ?                                                              | - (after being stimulated by a question) yes sir. (Subject was silent for a long time when rereading question number 2), the length and width of the letter paper, so minimal paper was needed. (looks unsure). |

The results of this study are in line with [19] findings show that there is no significant difference in thinking ability between male and female students. However, gender and proficiency level did not make a significant difference. different from the results of Kusumaningsih, et al. research which stated [20] Gender has a significant influence in thinking to understand mathematical concepts, it is revealed that the cognitive style of men is better than that of women. Gender differences in creative thinking are minimal and depend on the level of education; women at the primary and secondary education level have lower creative thinking on the Figural Originality Index and Figural Creativity lower than men with the same level of education [21]. Women with university level education have higher creative thinking on the aspect of verbal fluency than men at the same level. [22] research results indicate that gender and thinking style are significant factors in influencing creative thinking abilities. However, there is no significant interaction effect of the two variables on the overall creative thinking ability. [23] Gender has a significant influence on critical thinking and creative thinking. Torrance argues that there was no gender difference in performance at tests, measured creative potential, but there were some significant differences between genders in self-perception: female did not perceive themselves as inventors and were strongly influenced by their environment [22].
4. Conclusion

Gender differences do not have a significant effect on students' creative thinking. Creative thinking process in solving algebraic problems in male students (SKL) and female students (SKP), can be explained as follows; On the aspect of fluency, subject are able to convey clearly that there are problems that need to be resolved in the information provided, write correctly and completely the information that is known and asked. Subjects fluent in expressing definitions, lemmas and arguments that support the complete completion process and formulating appropriate resolution strategies. Subjects were able to interpret the problems in the questions into algebraic equations correctly. Subjects are not fluent in implementing the process completion strategy which is marked by incomplete answers but the steps taken are correct and unable to predict the time it will take to solve a problem correctly. The subject has not been able to ascertain every step taken in the implementation of problem solving according to planning (monitoring). Subjects has not carried out the evaluation process properly because it only re-reads what has been done. On the aspect of flexibility; The subject has not been able to provide different alternative strategies to solve the given problem so that the flexibility of the subject is still low. On the aspect of originality; On the aspect of originality; The novelty of the process of solving the subject's problem is seen when the subject is able to sketch the problem into a picture and form algebraic equations that appear even though they are not able to solve the problem completely.

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