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ANALYSIS OF STUDENTS CREATIVE THINKING ABILITY IN SOLVING HOTS PROBLEMS BASED ON GENDER DIFFERENCES

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ABSTRACT

This study aims to describe the differences in creative thinking skills of SMA Negeri 1 Wundulako students in the 2024/2025 academic year to compare male and female students performance in solving HOTS questions. This research employed a qualitative approach. The subjects in this study were class XI students at SMA Negeri 1 Wundulako, using a test developed based on HOTS (High Order Thinking Skill) and creative thinking indicators. Furthermore, based on the test results, six students were selected, consisting of three boys and three girls representing high, medium, and low levels of creative thinking, to be further investigated by interviews. The results showed that, Female students performed better in fluency, flexibility, and elaboration, while male students excelled only in originality. Based on these results, it can be concluded that female students demonstrated greater ability in analyzing information and elaborating problem solving

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1. INTRODUCTION

Education plays an important role in improving the quality of human resources. The world of education is particularly concerned by the need to develop and assess 21st century skills, because it represents the first link in the chain of skills acquisition, preparing the human resources of tomorrow (Thornhill-Miller et al., 2023). According to

Permendikbud No. 56 of 2013 “process standards” mentioned that the learning process in the educational unit held interactively, inspirational, fun, challenging, motivate learners to participate actively, and provide sufficient space for initiative, creativity, and independence in accordance with the talents, interests and development physical and psychological learners (Ratnasari et al., 2018). The meaning of participate actively is using the senses such as assembling tools in practicum activity while active in thinking determined based on creative thinking skill and critical thinking skill (Wulansari et al., 2019).

In line with the objectives of national education, the 21st Century Education Framework developed by the World Economic Forum (WEF) states that students need to ensure they have 16 essential skills; these 16 skills are classified into three major groups: foundational literacies, competencies, and character qualities (character education) (Agenda, 2016). One of these skills that students must have based on the context of competencies is creativity, which includes the ability to think creatively (Qomariyah et al., 2021). This 21st century skill should be able to be implemented in our education system (Wulansari et al., 2019). Creative Thinking is one of the 21st Century skills that students ought to master (Council, 2011;Iskandar et al., 2020). People who have a high level of creativity are able to find solutions to the problems they face. Thinking creatively involves generating uncommon and practical solutions and represents an authentic, innovative way of conceiving and addressing reality (Samaniego et al., 2024). Future generations will need to think creatively in order to thrive in our fast-changing world (Ritter et al., 2020). This brings attention to the need to foster creativity. Education plays a central role in fostering creativity in all learners.

Creative thinking is the ability of students to use their minds or train mentally on how to develop ideas or find new solutions to solving problems. According to Khuana (in Samaniego et al., 2024) define creative thinking as a form of thinking that enables the generation of novel methods, approaches, and perspectives to address challenging problems. Creative thinking also includes the ability to solve and get many possible answers as a solution to a problem. The more possible responses that can be given to a problem, the more creative a person is. (Dewi et al., 2019). Creative thinking is the ability to answer problems based on existing data / information with various alternative answers, the answers given show originality, flexibility, fluency, and elaboration (Rizal et al., 2020). Munandar described that the indicators of creative thinking include four indicators, namely: (1) Fluency thinking, (2) Flexible thinking, (3) Original thinking, (4) Elaboration ability, as shown in Table 1 (Maryati & Parani, 2021; Qomariyah et al., 2021).

Table 1 Criteria and Indicators of Creative Thinking Ability

Criteria Creative Thinking	Indicators
Fluency	Students understand the meaning, identify the problem presented, and analyze what is known and what is asked.
Flexibility	Students reflect the ability to consider different or alternative situations from those commonly provided
Originality	Students can think of problems or things that others have never thought of

Elaboration	Students take detailed steps to find a deeper meaning in the answer.

Creative thinking skills are also identified as HOTS (High Order Thinking Skill) (Febrianti et al., 2021). Therefore HOTS are important for students in developing their ability to think more creatively and analyze and evaluate a mathematical problem. When students are accustomed to being faced with high-level problems, it will not be difficult for them to analyze, evaluate, and create answers to obtain solutions to mathematical problems. HOTS is a skill that involves critical and creative thinking skills (Amina et al., 2020). HOTS questions are measurement instruments used to measure high-level thinking skills, namely, thinking skills that are not just remembering, understanding, or applying. However, according to Brookhart, HOTS questions test the ability to think, analyze, evaluate, and create (Widana, 2020).

A study stated that there are differences between male and female students that can be seen in how they think, understand, and solve problems (Buranda & Bernard, 2019). This is in line with the ability to think creatively in solving problems on the material of flat sides of space, which obtained higher mathematical creative thinking scores of female students than male students (Pratama et al., 2023). One of the study's results also shows that the relationship between gender and student learning achievement shows a strong influence because the structure and function of the male and female brains are slightly different. The results of the study show that women's learning achievement tends to be better than men's (Utami & Yonanda, 2020). In addition, research on mathematical communication skills (Dewi et al., 2021) and mathematical problem-solving skills (Annisa et al., 2021) shows that female students perform better than male students.

The gender referred to in this study is a specific understanding of gender in nature theory. Nature theory, which is supported by biological theory and structural functionalism theory, says that differences in gender roles stem from biological differences in men and women (Purnomo, 2012). Nature theory explains that what distinguishes roles between men and women is natural. This is due to the biological anatomy inherent in both, so the different sexes of men and women become the main factor in determining social roles (Khuza'i, 2012). Nature theory supposes that the roles of men and women are roles that have been outlined by nature (Purnomo, 2012).

Based on the results of interviews conducted with mathematics teachers and two students of class XI SMAN 1 Wundulako, it was found that class XI students were not accustomed to working on HOTS-based problems, and some students were still significantly lacking in advanced mathematics in the form of the ability to analyze problems, they were more likely to work on routine problems, which could result in a decrease in student creativity, which could affect students in finding solutions or solving problems. According to Sugiman's opinion, math problems whose difficulty level is slightly above the students ' ability but should not be outside the Zone of Proximal Development (ZPD) can generate students' desire to find solutions (Mashuri & Jahring, 2023). During the interview, the math teacher also said that there were differences between boys and girls during math learning, where female students tended to be more dominant in math lessons than male students.

Based on the description presented above, some of these studies have not been found that specifically analyzes the creative thinking abilities of high school students when solving mathematics higher-order thinking skills (HOTS) problems based on gender, concerning Munandar's indicators, so researchers are interested in researching how students' creative thinking skills in solving HOTS problems differ based on gender

at SMAN 1 Wundulako. This research was conducted to describe the creative thinking ability of high school students in solving HOTS problems in terms of gender differences.

2. METHOD

This study employed a qualitative descriptive approach. According to Sugiono (in Wijaya 2020) a descriptive method analyzes data by describing the collected data as it is. This research describes how students' creative thinking skills in solving HOTS-based problems differ based on gender The research subjects will be given HOTS-based questions to assess creative thinking skills.

The primary instrument in this study was the researcher, supported by test sheets and semi-structured interview guides. The test questions consisted of three questions about creative thinking skills (questions made based on HOTS), which were used to determine creative thinking skills through four indicators of creative thinking, namely fluency, flexibility, originality, and elaboration. The test items were developed by the researcher and validated by two experts: a mathematics education lecturer and a mathematics teacher. Following the test, semi-structured interviews were conducted. The interview was conducted to determine the subject's reasons for answering questions. This research was conducted in the even semester at SMAN 1 Wundulako. The subjects of this study were grade XI students.. Furthermore, based on the test results, six students will be selected, with 3 boys and 3 girls, divided into three criteria of high, medium, and low creative thinking ability, to be further investigated by interviews. Subjects for interviews will be selected based on the test results of the creative thinking ability test.

After analyzing the test results, three male students and three female students were selected who could represent each KKTP categorization (Minimum Mastery Criteria for learning Objectives). which will then be described in the interpretation of the level of creative thinking ability according to (Febrianingsih, 2022):

Table 2 Range and Level of Creative Thinking Ability

Total Score Range (%)	Level of Creative Thinking Ability
81-100	Very Creative
66-80	Creative
56-65	Moderately Creative
41-55	Less Creative
0-20	Not Creative

Data analysis in this study involves reducing data, presenting data, and drawing conclusions. To ensure data validity, triangulation was employed by comparing interview and test results. The triangulation technique referred to in this study is the test and interview method to check the validity of the data.

3. RESULTS AND DISCUSSION

3.1. Results

Creative thinking is analyzed using the indicators Munandar (2012) presented: fluency, flexibility, novelty, and elaboration. The results of the recapitulation of statistical data describing students' creative thinking abilities are presented in the following table:

Table 3 Percentage of student creative thinking ability test results

Aspects Measured	Percentage (%)	
	Male	Female
Fluency	56,67%	59,80%
Flexibility	32,50%	46,32%
Originality	82,50%	80,88%
Elaboration	73,33%	82,35%

The result obtained from:

$$P = \frac{\sum TSs}{TSm} \times 100\%$$

Information:
$P =$ Percentage of creative thinking ablility indicators
$\sum TSs =$ Total student score
$TSm =$ Total maximum score

The data obtained is processed by calculating the percentage of the score obtained by students on each indicator of their creative thinking ability. The formula used is according to (Putri & Suripah, 2022).

Table 4 shows that female students achieved higher percentages in three out of four creative thinking indicators, particularly in elaboration (82.35%) and flexibility (46.32%). Meanwhile, male students slightly outperformed female students in originality (82.50% vs. 80.88%). These results suggest that while both genders demonstrate strengths in creative thinking, female students exhibit more consistent performance across all indicators.

3.1.1. Male Students' Creatuve Thinking Ability Test Result

The following table presents the results of the written test of male students' creative thinking ability based on the indicator category and interpretation.

Table 4 Male Student test results

St. Code	Indicators				Total	Percentage and Level	
	1	2	3	4			
SL-1	10	7	3	12	32	86%	Very Creative
SL-8	6	5	3	10	24	68%	Creative
SL-7	2	0	4	8	14	46%	Less Creative

According to Table 5, three subjects of the male gender show different levels of creativity. Subject SL-1 scored 32, translating to 86%, categorizing it as Very Creative. This score reflects SL-1's exceptional ability to demonstrate creative thinking skills across the assessed indicators. In contrast, subject SL-8 scored 24, or 68%, placing it in the Creative category. While SL-8 shows commendable creativity, significant room remains for improvement to fully realize its potential. Meanwhile, subject SL-7 scored only 14, equating to 46%, firmly categorizing it as Less Creative. This low score highlights an immediate need for attention and development in SL-7's creative skills.

3.1.1. Female Students' Creatuve Thinking Ability Test Result

The following table presents the results of the written test of female students' creative thinking ability based on the indicator category and interpretation.

Table 5 Female Student test results

St. Code	Indicators				Total	Percentage and Level	
	1	2	3	4			
SP-23	10	8	4	12	34	96%	Very Creative
SP-14	10	3	4	10	27	76%	Creative
SP-6	2	3	2	10	17	47%	Less Creative

Information:
1 = The fluency indicator
2 = The flexibility indicator
3 = The originality indicator
4 = The elaboration indicator

Table 6 displays the creative thinking abilities of female students at three different levels. Subject SP-23 achieved nearly perfect results, scoring 34 points, which translates to 96%, placing her in the Highly Creative category. Next, Subject SP-14 received a score of 27, equivalent to 76%, and was categorized as Creative. Although her creativity is commendable, there is ample opportunity for further growth and improvement. In contrast, Subject SP-6 had the lowest score of 17, or 47%, which placed her in the Less Creative category. These results highlight a critical need to develop her creative thinking skills. Overall, these findings emphasize the diversity of creativity among female students.

3.2. Discussion

Based on the analysis of students mathematical creative thinking abilities by gender, interesting differences are observed in each indicator. For the fluency indicator, female students tend to outperform male students. This suggests that female students are generally more focused when understanding problems and recalling previously learned solutions. Regarding flexibility, female students also show greater ability than their male counterparts, although both groups still demonstrate relatively low flexibility. This may be due to challenges in making comparisons or decisions when faced with new problems. Regarding originality, male students slightly surpass female students, indicating that both

genders can generate unique ideas, but male students tend to be more prominent in this aspect. Meanwhile, in the elaboration indicator, female students again show superiority, as their answers are typically more detailed, and they are better at recalling and applying previously learned material. These findings highlight that female students generally excel in fluency, flexibility, and elaboration, while male students tend to be more original in their creative thinking in mathematics.

Table 4 shows that the fluency indicator obtained 56.67% for male students and 59.80% for female students (fluency), with female students being superior. The flexibility indicator percentage obtained was 32.50% for male students and 46.32% for female students, which shows that female students have much more flexibility than male students, even though both tend to be low. The originality indicator percentage obtained was 82.50% for male students and 80.88% for female students. The data shows that male students are slightly superior to female students, although overall, both are classified as high. The elaboration indicator percentage obtained was 73.33% for male students and 82.35% for female students; female students were superior.

The creative thinking ability test results on male students in Table 5 show that students (SL-1) obtained high scores on each indicator. Students (SL-1) have fulfilled the indicators of creative thinking ability by interpreting Very Creative. Furthermore, students (SL-8) with Creative interpretation, showed high scores on the Novelty and Elaboration indicators but still lacking in the fluency and flexibility indicators, it can be interpreted that (SL-8) has been able to generate new ideas or solve things that have never been thought of by others and solve the problem in detail until the end. However, it is still challenging to identify the problem given and difficult to consider the situation presented in the problem. Finally, students (SL-7) with a Less Creative interpretation, showed a high score only on the Novelty indicator, meaning that students (SL-7) are only able to generate new ideas in solving a problem but still have difficulty in solving the problem in detail until the end and have not been able to make decisions or considerations based on the problem given.

The creative thinking ability test results on female students in Table 6 show that students (SP-23) obtained high scores on each indicator. Students (SP-23) have fulfilled the indicators of creative thinking ability with a Very Creative interpretation. Students (SP-23) have been able to generate new ideas in solving problems and identify the issues given so that they can make decisions or considerations based on the problems presented. This indicates that students (SP-23) have optimal creative thinking skills. Furthermore, students (SP-14) with Creative interpretation, show high scores on the originality, elaboration and fluency indicators but are still lacking in the flexibility indicator, it can be interpreted that (SP-14) has been able to generate new ideas or solve things that have never been thought of by others or identify problems found in the problem and can solve the problem in detail until the end. However, (SP-14) is still significantly lacking in considering the situation given in the problem. Finally, students (SP-6) with a Less Creative interpretation, show a high score only on the elaboration indicator, but are still very lacking in the fluency, flexibility, and originality indicators, meaning that students (SP-6) have difficulty making decisions or considerations and have not been able to generate new ideas based on the problems given in the problem. Students (SP-6) also have difficulty identifying the issues presented in the problem.

Based on the results presented in Table 5 and Table 6, students (SL-1) and students (SP-23) who are included in the Very Creative category show that students (SP-23) have slightly superior creativity overall. Both students have the same score on the fluency and

flexibility indicators and only a slight difference in the originality and elaboration indicators, although still classified as very good. This means that both students have optimally fulfilled all indicators of creative thinking skills.

Furthermore, in Creative interpretation, students (SP-14) are superior in the fluency and originality indicators which means female students are better at identifying information contained in a problem and generating ideas that have not been thought of by others, but students (SL-8) excel in the flexibility indicator which means male students are better at considering situations that are different from others. In the elaboration indicator, both students obtained the same results, indicating that both had been able to solve a problem in detail until the end well.

Both students only excel in the Elaboration indicator in the less Creative interpretation. However, students (SP-6) obtained slightly higher results which means that both of them have been able to solve the problems given in detail until the end. In the fluency indicator the two students obtained the same score, both students still had difficulty identifying the information presented in the problem, even in the flexibility indicator students (SL-7) had not been able to provide answers at all, meaning that they had not been able to make considerations with different situations given compared to students (SP-6) who were slightly superior although still classified as low. However, in the Originality Indicator, students (SL-7) can obtain excellent results and are superior to students (SP-6), thus students (SL-7) have been able to generate new ideas that have not been thought of by others well.

Based on the results above, male students were slightly superior in novelty compared to female students. Although male students scored higher in originality, their lower performance in other indicators suggests a more uneven creativity profile. In general, the creative thinking ability of female students was higher in other indicators such as fluency, flexibility, and elaboration. This shows that male students tend to be more able to generate new ideas or solutions that have never been thought of before when solving HOTS problems. One of the reasons is the tendency of male students to take more risks and think out of the box, male students to take more risks and think “out of the box” when faced with problems (Shen et al., 2018). The implications of these findings, both theoretical and practical, are significant. Theoretically, these results strengthen the understanding that there are differences in creative thinking styles based on gender, especially in the novelty of ideas. This finding can be the basis for further research on developing students’ creativity by considering gender factors. Meanwhile, practically, teachers and education policymakers can utilize this information to design learning that is more responsive to the uniqueness of each gender. Thus, the creative potential of all students can be optimized in a balanced manner so that learning outcomes and the development of 21st-century competencies can be achieved more evenly.

A high score on a single indicator, such as novelty, cannot categorize a student as fully creative. This study used four leading indicators to assess creative thinking skills: fluency, flexibility, originality, and elaboration. The research found that some students who scored high on one indicator, for example, novelty, but low on other indicators were only categorized as “less creative” or “moderately creative”. Students who only meet one indicator are not necessarily categorized as creative but only show potential in certain aspects, a complete assessment of creativity is only given if students can fulfill most or all of these indicators (Nadhiroh et al., 2023;Nurdiana & Caswita, 2024)For example, a male student (SL-7) who only excelled on the novelty indicator but was weak on fluency, flexibility, and elaboration was not categorized as highly creative. This shows that

optimal creativity is only achieved if students can show high abilities equally in all four indicators.

Female students have a higher level of creative thinking ability than male students in almost all indicators of creative thinking ability. Female students are better able to identify information in the problems given, generate new ideas that others have not thought of, and solve problems in detail to completion correctly and adequately. This supports previous findings by Kurnia et al., (2021)which argue that female students tend to demonstrate better metacognitive awareness likely contributing to higher performance in elaboration and fluency. Meanwhile, male students sometimes show superiority in the flexibility indicator, which means they are more flexible in considering various situations or different points of view, even though they are still below female students on average. This is in line with research conducted by Maryanto & Siswanto, (2021), which revealed that male students are better able to think more flexibly by providing several answers to each problem. However, when compared, female students' creativity scores remain higher than male students. This can be seen in the interpretation of creative thinking skills at each level, female students are superior to male students.

However, this difference is not always significant in each individual, because male students also stand out on specific indicators such as originality or flexibility. This shows that the gender factor does affect creativity. However, it is not the only determinant, because the learning environment, motivation, and experience also play a role in the development of student creativity. Thus, on average, female students are superior in creative thinking than male students, although these advantages can vary in each individual.

4. CONCLUSION

The results showed that female students' creative thinking skills were generally superior to male students in solving HOTS (Higher Order Thinking Skills) questions. Female students stood out in three leading indicators of creative thinking: fluency, flexibility, and elaboration. The percentage scores on these three indicators were higher for female students, indicating that they could better understand the problem, provide various solutions, and elaborate on the steps in detail. On the other hand, a significant difference was found in the novelty indicator, where male students were slightly superior to female students. Male students tend to be more risk-taking and generate new ideas that have never been considered. However, this advantage is not followed by equal ability in other indicators. Overall, this study confirms that optimal creativity requires excellence in all indicators, not just one aspect. The findings also show differences in creative thinking styles based on gender, which can be important in designing learning strategies and developing student creativity in schools.

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