Gender Differences in the Reasoning of 5th Grade Students in Mathematics Problem Solving

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Abstract. *The purpose of this research is to describe the reasoning of male and female pupils when solving mathematical problems. In this study, descriptive research with a qualitative methodology was used. Subjects were chosen based on their outstanding mathematical abilities. Math ability tests, math problem solving test data, and interview data were used to collect study data. The findings revealed that male pupils solved math problems differently than female ones. This is obvious from the outcomes of math problem solving exams and interviews. Male students are less confidence in their own opinions and rely on researchers for assistance, but female students are more confident when expressing their replies to researchers.*

Keywords: reasoning, solving mathematical problems, gender

1 Introduction

Mathematics is one of the subjects taught in primary schools that is seen to be crucial in improving children' thinking abilities. The direct goal of learning mathematics is to cultivate reasoning and skill growth from concepts, namely thoughts or ideas produced from the same qualities [1]. According to Schoevers [2], the concept of problems in mathematics is utilized to stimulate or improve pupils' creative thinking. Critical thinking is an organized form of rea-soning abilities, whereas reasoning is a cognitive process that connects data to previously un-known conclusions. Reasoning is a mental process that allows humans to discern between good and bad things, hence every human being must be able to reason. Students' reasoning skills can be seen in their ability to solve difficulties, because given problem solving can stim-ulate students' thinking strategies to answer these problems [3]. Learning mathematics has a significant purpose, which is to solve mathematical problems; in fact, this process is at the center of mathematics. The question is deemed to be a problem if it is difficult to answer and needs pupils to solve it in an innovative method; these questions are sometimes referred to as non-routine inquiries [4].

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Polya contends that there are four steps to solving a problem: (a) understanding the prob-lem contained in the problem because understanding the problem gives you the right way to solve it, (b) making a good problem-solving plan, (c) implementing a previously made prob-lem-solving plan, and (d) rechecking answers or work that has been completed. These four processes demonstrate how students solve issues, allowing students' reasoning skills to be as-sessed [5], [6]. When students are in primary school, they learn to think through challenges. His perceptions are realistic and critical at the age of 10 to 12 years. Children can reason logi-cally since they already have comprehension and awareness. Youngsters aged 11 and under, according to Piaget [7], are not yet able to employ logic in their minds, whereas elementary school-age youngsters can go through causal sequences and have various approaches to solve issues.

Boys and girls have different intellectual capacities in elementary school, with girls having greater verbal skills than boys and boys having higher spatial abilities than girls. In general, men and women have significant distinctions, such as Santrock's belief that gender relates to a person's socio-cultural aspects as a man and a woman [8]. According to the interview results, a grade 5 teacher at an elementary school in Surabaya believes that girls are more engaged dur-ing the learning process and that boys frequently speak among themselves with their friends when the instructor is explaining. However, the majority of participants in the National Sci-ence Olympiad were male students, and more than half of the participants were male students from other provinces. Men and women have diverse habits and qualities that necessitate dif-ferent treatment. Men and women differ in a variety of ways. Men have a stronger physique and more responsibilities than women, whereas women have superior verbal skills. In order to determine student achievement, the instructor must first understand the reasoning capacities of male and female students by offering an assessment that the teacher can do during the learning process. Because male and female students' reasoning abilities differ.

2 Methods

This study employs a descriptive research design and a qualitative technique. This type of investigation is utilized to evaluate objects that have natural circumstances. The research data consists of mathematical ability test results, mathematical problem solving test results, and interview results. Data from mathematical ability tests is used to select and determine the top-ics for research. The reasoning analysis data of grade 5 primary school children in solving mathematical problems in terms of gender disparities were analyzed using problem solving test data and interview data.

The primary instrument is the researcher herself, whereas the first supporting instrument is a mathematical ability test that researchers employ to determine or choose research subjects with strong mathematical abilities. Second, a math problem-solving test, consisting of math story questions that will be assigned to the chosen subject. Third, the interview guide is a supporting device used to learn more about how the subject solves problems. Because not all of the steps the subject takes can be stated on

the response sheet and to ensure the intent is written by the students on the answer sheet, the contents of the interview are in accordance with Polya's problem-solving stages. Fourth, the observation sheet employed by the researcher in this study was in the form of a rubric. The fifth is a validation sheet, which is used by re-searchers to determine the instrument's validity or suitability for the problem under study.

The test method was utilized to collect data in this study. There will be two types of tests administered: a math ability test and a math problem solving test. The following interview method is observation or observation and validation. The data analysis technique employed is written test result data, specifically the first analysis of the mathematical ability test, where the test results will be sorted according to the requirements for the mathematical ability cate-gory. The subject was chosen by the researcher based on a math aptitude test result of 80 to 100. The second analysis of the math problem-solving test.

The selected subjects will be given arithmetic tasks in the form of word problems in this study. The Polya problem solving stage must be used to answer each number. Understanding the problem, designing a solution, carrying out the plan, and checking again are the stages of solving the Polya problem. After reviewing the problem-solving test, the researcher examined the interviews with the selected subjects. Data reduction (Data Reduction), data presentation (Data Display), and generating conclusions (Conclusion) are all part of the analysis [9].

The researcher assessed the validity of the data, namely: credibility (credibility test), to de-termine or confirm its validity. In this study, the reliability test was utilized to determine if the observation period should be increased or decreased. The researcher employed triangula-tion and member check as credibility tests [10]. Triangulation is the process of verifying data from many sources in different ways and at different periods. There are three types of triangu-lation: source triangulation, data collection technique triangulation, and time triangulation. The researcher only used source triangulation and data collection approaches in this case. Checking the authenticity of data from many sources, typically teachers and pupils, is known as source triangulation. Tests, interviews, and observation or observation sheets are examples of data collection approaches. Following data collection, researchers perform member checks to re-check the data that has been obtained.

3 Findings and Discussion

3.1 Results

The findings of the mathematical ability test data supplied to 21 students revealed that 7 male students had low mathematical ability, 1 student had moderate mathematical ability, and 1 student had strong mathematical ability. There were as many as 5 female pupils with low mathematical talents, 6 with moderate mathematical abilities, and 1

with strong mathematical abilities. The following are the specifics for each research topic:

Table 1. Female Students' Mathematical Ability Test Scores:

Name	Score	Math Ability Group
NSW	80	High
HMS	70	Medium
NBL	70	Medium
LY	60	Medium
SYH	60	Medium
DYRA	60	Medium
NL	60	Medium
RC	50	Low
TSY	50	Low
FWWZH	30	Low
CNTSY	30	Low
ZZHR	0	Low

Table 2. Male Students' Mathematical Ability Test Scores:

Name	Score	Math Ability Group
GTR	80	High
MHNDR	70	Medium
WR	50	Low
RGY	40	Low
FRL	40	Low
GLNG	40	Low
SDY	30	Low
FRG	20	Low
DFZ	20	Low

The researcher attempted to provide arithmetic problem solving tests to students with strong mathematical ability, namely one male and one female student, among the pupils who had been divided into three levels by the researchers.

Based on the outcomes of the math problem-solving test. The results of the arithmetic problem solving test data for grade 5 primary school pupils will be presented by the researcher. According to Polya, the goal of this analysis is to gain a description of each student's reason-ing in solving mathematical problems. Each phase of Polya has been carried out based on the results of data analysis on male participants solving mathematical problems.

The first step is understanding the problem. Based on the subject's answer sheet, it can be determined that the subject comprehended the problem in number 1 and was able to answer and record the information contained in the problem. On the subject's answer sheet, the sub-ject has written down what is known and what is asked. However, because the subject cannot be written briefly, it is the same as in the problem. The topic also did not write it completely at the end of the answer while writing information. According to the findings of the research-ers' interviews with the male subject, the subject understood the problems in questions 1 and 2, but when the subject explained or retold the problems in the questions, they were still not fluent and did not use their own sentences. They are still reading the questions and lack con-fidence in giving them, therefore they occasionally require the assistance of researchers. In question number 2, the subject was also able to understand the current problems; all of the in-formation in question number 2 was also written by the male subject; nevertheless, in answer number 1, the subject did not provide entire information in the answer. During the interview for question number 2, there was also a lack of confidence when expressing the situation to the researcher, although the subject grasped the issue.

Polya's second step is to prepare a problem-solving strategy; nothing is wrong in this stage, as seen by the student's solution sheet. Question number one was answered by the subject. However, when the researcher interviewed the subject, it was discovered that the subject in-tended to solve the problem and answer it at the same time. When discussing the subject's strategy to the researcher, there is no story or plot to explain it, thus it is all in the form of figures and responses. Similarly, when developing a plan, the subject instantly answered ques-tion number two. As a result, while responding inquiries or putting a problem-solving plan in-to action immediately after the subject plans it. When it comes to re-checking completed work, the subject checks but merely looks at it to ensure that there are no unanswered ques-tions. That applies to any questions that have been presented just for the purpose of observa-tion and will not be tallied again.

The data on female subjects in solving mathematical problems is then analyzed. The female subject followed the same steps as the male subject. The first step is to understand the prob-lem, which the female subject has done by answering question number

one. The patient has also been able to write down known information and brief questions without rewriting them as included in the problem. The description is also full in writing; at the end of each answer, the subject adds or accentuates it by using the word "so." So that researchers can learn more about the responses of female respondents. According to the findings of the researchers' inter-views, the female subject was able to relate the issues in question number 1 easily and utilize her own language clearly. As a result, when reiterating problem number 1, the researcher felt quite familiar with the flow of students' thoughts. However, in response to question number one, the person was careless with his or her response and answered incorrectly. The respond-ent stated that he was unaware of this until the researcher conducted an interview with him. The subject then comprehended the difficulty in question number two and had written down what was known and questioned briefly before using the knowledge in the final solution. The individual additionally included the word so at the conclusion of his response to reaffirm his response. The findings of the interview on issue number two were likewise quite pleasing be-cause the subject was able to recount the situation coherently and confidently using his own language.

The following phase is to plan problem solving; based on the interview results, the subject intends to thoroughly tackle the problem. When the researcher asks what the subject intends to do, the subject responds by revealing the plot and using knowledge from the problem. The subject just explained his plans and did not respond right away. This also applies when the subject tells the researcher question number two; both tell the researcher in a logical and un-ambiguous manner what the subject will do to get the solution. The following stage is to carry out the problem-solving strategy, ensuring that the plan that the subject previously devised is carried out correctly and in accordance with what was planned. In terms of re-checking the re-sults of his work, the subject determined whether or not the subject's responses were correct by looking at each number. However, the subject did not recall the answers, instead focusing solely on each number.

3.2 Discussions

The results of the reasoning analysis of fifth grade elementary school pupils in solving mathematical issues were examined based on gender differences, as follows, based on the study of the results of math problem solving exams and interviews. Math problem solution by a boy pupil. Understanding the problem is the first stage indicated by Polya for solving math problems. According to the researcher, the subject of SL1 has comprehended the problems in-cluded in questions 1 and 2. The subject has clearly retold what is intended in the problem, but he has not been able to describe the math problem in his own language and still need the assistance of researchers when discussing the challenges contained in the problem. The SL1 student has also noted or written down what is known and what is being questioned in ques-tions 1 and 2. According to Kenedi [11], one is said to understand a problem if he knows what he knows and what is being asked. This leads to the conclusion that male students grasp these issues. This is also

consistent with Sagala [12] that there are disparities in conceptual compre-hension results between male and female students, with male students performing better than female students.

The subject does not explain the problem through narrative, but rather by the statistics in the questions. So, when subject SL1 explained the subject's plan, the subject indirectly pro-vided the answer. The SL1 subject mistakenly delivered the answer while developing a plan, therefore in this third stage, the subject had carried out the plan properly and in accordance with what had been planned. In terms of re-checking work, topic SL1 has checked it but merely looks at it to see if there is still something that hasn't been replied. Just be careful not to recalculate the answer.

In the first stage of solving female students' arithmetic issues, namely understanding the problem, the SP1 subjects as a whole already grasped the problems contained in the questions. SP1 students can also clearly communicate their concerns in their native language. Subject SP1 has additionally noted on the answer sheet what is known and what is being questioned. Subject SP1 intends to address the problem in his own language, fully explaining to the re-searcher the flow of plans that the subject has devised. During the interview, the subject was very confident and excited during the planning stage, but there was a writing error by the sub-ject because he was not careful when writing. The topic has used all of the information in the question to answer it.

The third stage is to plan a problem-solving strategy developed by subject SP1; at this point, the subject has successfully implemented the plan. Re-checking the subject's work or respons-es for the fourth stage has still not checked the entire. The subject just sees the same thing as the SL1 subject, but the difference is that the SL subject only checks it to make sure nothing has been responded, but the SP1 subject looks at the response to see if it is correct or incorrect but does not count.

This demonstrates that female students have more structured and beautifully written plans in an effort to solve difficulties, as opposed to boys, who solve problems as soon as they com-prehend what problems must be solved without first meticulously writing down the strategy. According to Ardito [13], boys focus more on the operational parts of building and coding in issue solving, whereas girls focus more on group dynamics in terms of what has to be dis-cussed in problem solving.

The researcher will assess the student worksheets and the time they were finished after re-viewing the work results and interviews of male and female students. Even though the sub-jects wrote on HVS paper or paper without lines, the male students' worksheets were neater and their writing was more aligned, according to the researcher, whereas the female students' writing was tilted downwards. Female students had more streaks from topic counting than male students, based on how they performed on the math problem solving test and the first math aptitude test. The researcher concludes that the male subject is neater since calculating on another piece of paper makes the answer

page cleaner and tidier. Female student subjects, on the other hand, were more comprehensive in their answers, writing precisely how the sub-ject counted on the answer sheet, making it easier for the subject to work on. Furthermore, the female subject wrote a description of each answer to make it more understandable.

This demonstrates that the boy's manner of thinking and reasoning allows for his own thinking in compiling the steps for solving while remaining simple and leaving the solution page clean. Meanwhile, the females express themselves on the answer sheet by offering vari-ous details to make things easy for themselves. This is consistent with Valanides' assertion that boys benefited more from the individualistic, kinesthetic, spatially-oriented, and manipu-lative-based activity with the cards, while girls benefited more from the collaborative writing activity [14].

The time allotted for working on math problems is 60 minutes. From then on, the female subject made the most of it by working hard and concentrating on the questions provided to her. If the participant was unsure or didn't comprehend a question, she took the initiative to ask the researcher. Then, male subjects tend to be more silent when working, and the subject occasionally daydreams. The subject required a few extra minutes within the 60-minute time limit. When the subject daydreams, the researcher asks, and it turns out that the subject does not comprehend some of the questions, so the subject asks the researcher after the researcher approaches. When working on the questions, the male participants were more relaxed than the female ones, who appeared frantic for a few moments when they sensed the time was running out. This is as expressed by Syahruddin [15] that men and women have diverse brain struc-tures, which results in various learning methods and styles. Men learn better when they are exposed to hands-on tasks such as practicum, design, and tool assembly, as well as minimum communication (verbal and nonverbal). Meanwhile, women prefer to learn through communication-related methods and styles such as lectures, speaking, writing, casual talks, or presenta-tions.

Furthermore, to find out or check the validity of the data, the researcher conducted a credi-bility test, namely by triangulation and member checks. Trangulation consists of several types and researchers use triangulation of sources and data collection techniques. Source triangula-tion, namely checking the validity of data from various sources, namely grade 5 students and grade 5 teachers. The researcher then conducted math ability tests, problem solving tests, and interviews with grade 5 students, while another source, namely the grade 5 teacher, was ques-tioned about students who receive ratings, what the class teacher thinks about male and fe-male students during learning, and student learning outcomes. Member check triangulation, or re-checking acquired data, is done by researchers after researchers have conducted research, and by conducting member checks, researchers can examine the data that researchers have ob-tained. Based on the findings of the research, it is possible to conclude that male and female pupils solve math problems in different ways. Female students are more confidence when telling re-searchers about difficulties and how to fix them, but male students still

require the assistance of researchers. This is not to say that male students are unaware of the issue. However, this is owing to disparities between the two, specifically that female students have stronger verbal ability than male students, who tend to act quickly [16].

4 Conclusion

According to the findings of the researchers' research and discussion on the reasoning anal-ysis of grade 5 elementary school students in solving mathematical problems in terms of gen-der differences, male students can understand the problem well, but when it comes to deliver-ing it back using their own sentences, male students -Men can't yet, still need the help of re-searchers. Male students can carry out their plans in planning and carrying out the plans that have been created, but the plans that the subject makes are very to the point, so when plan-ning and right away the subject promptly answers. The male student subject checking again just examined or re-checked to ensure there were no unanswered queries.

The female student has comprehended the subject and can retell it fluently and clearly in her native language. The female subject additionally communicates coherently how the plan will be formed by linking the facts gathered from the problem when intending to tackle the problem. And it has also been carried out in accordance with what was previously intended. The female student re-checked each figure but merely to see if it was in accordance with what she had planned; the student did not attempt to recalculate.

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