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ANALYSIS OF STUDENTS' REASONING ABILITY, MATHEMATICAL CONNECTIONS, SELF-EFFICACY, AND DIFFICULTIES IN SOLVING PROBABILITY STORY PROBLEMS

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Abstract

This research aims to describe reasoning abilities, mathematical connections and self-efficacy as well as the difficulties faced in solving opportunity material story problems in each category of reasoning ability, mathematical connections and self-efficacy. The type of research used is survey research with a quantitative and qualitative approach. The population of this study were all public junior high school students in Sleman Regency, Yogyakarta. The research sample was taken using a proportional stratified random sampling technique with a sample size of 384 students. The results showed that students' mathematical reasoning abilities were included in the medium category with an average value of 57.92 to 60.52, students' mathematical connection abilities were included in the medium category with an average value of 59.64 to 62.98, students' self-efficacy included in the medium category with an average value of 68.35 to 70.41.

Keywords: Difficulty; Opportunity; Mathematical Reasoning; Mathematical Connection; Self-Efficacy.

INTRODUCTION

Data indicates that many students still experience difficulties in learning mathematics. Grunner (2020) to note from a total of 164 students, 89.02% reported that they still experience difficulties in learning mathematics. The students expressed that mathematics lessons involve too many rules and formulas, leading them to rely heavily on memorization. Teachers tend to focus on mathematics itself rather than on the students' thinking processes, resulting in a lack of in-depth diagnosis of the students' difficulties in learning mathematics (Wijaya et al., 2019).

Mathematics concepts are interconnected with one another. If students do not understand the concept of one topic, this lack of understanding will affect their comprehension of the topics that follow. This can lead to difficulties in grasping the material and ultimately result in errors when solving problems (Mursyida & Amalia, 2019). These difficulties will result in students making errors when solving problems. The common mistakes made by students indicate that they are experiencing difficulties. Therefore, it is necessary to analyze the challenges faced by students in solving math problems.

The process of solving a problem in the field of mathematics at school is usually presented in the form of a word problem (Drysdale & McBeath, 2018). Solving a problem presented in the form of a story is not an easy task because it is not solely dependent on the final outcome. Students must first understand the content of the problem, and then draw conclusions about the object that needs to be solved by using mathematical assumptions or models represented by mathematical symbols. Putridayani & Chotimah (2020) stated that the difficulties students face in solving word problems stem from their lack of careful attention, leading them to often perceive math word problems as abstract and difficult to understand. The lack of interest in learning mathematics is one of the reasons why students struggle with word problems. Students often prefer direct questions because they find them clearer compared to word problems, which require careful reading beforehand (Hurks & Loosbroek, 2014). Therefore, many students still face difficulties in solving word problems (Drysdale & McBeath, 2018).

The material that is often presented in the form of story problems is probability (Rodríguez-Nieto et al., 2021). Probability is one of the subjects that students must master because it is a mathematical concept needed in daily life to estimate the likelihood of an event occurring (Riana & Fitrianna, 2021). Rodríguez-Nieto & Alsina, (2022) stating that

probability is an important concept for students to master because it is required at higher levels. Probability offers students the chance to reason and connect with opportunities that may arise from one or more events. However, in reality, students have not yet been able to study probability material to the fullest extent. This statement is consistent with the results of the research Riana & Zanthy (2020) which states that there are still junior high school students who face difficulties in solving probability problems. This occurs because the students have not fully mastered the material. Students only know and have studied the probability material but do not understand or are able to use it to solve a mathematics problem related to probability. This statement is supported by Hurks & Loosbroek (2014) which states that the students' ability to understand probability material is still lacking, with 58.33% of students not yet understanding the probability material. The research conducted by Liu et al., (2020) shows that in studying probability, students experience several difficulties, such as difficulties in determining the sample space and event space, difficulties in solving problems related to the complement of events, difficulties in solving compound event problems, and difficulties in solving enrichment problems or word problems.

The resolution of a problem and proof will not occur without reasoning, and both are ways in which students develop reasoning and understand mathematical ideas. Reasoning is then used again to make decisions (NCTM, 2009). That is supported by Sholeha et al., (2021) which states that the greatest weight is given to the cognitive aspect, specifically reasoning. This statement indicates that reasoning is an important ability, making it a competence that students must master. Reasoning is one of the fundamental skills needed by students in the process of learning mathematics, as reasoning is required at almost every level of mathematical understanding (Mata-Pereira & da Ponte, 2017; Sidenvall et al., 2015). Mathematical reasoning skills help students develop an understanding of ideas and concepts involved in procedures. This means that when students engage in mathematical reasoning, they do not simply memorize formulas and procedures; they also strive to understand the ideas and concepts being used (Bieda et al., 2014).

The ability to make mathematical connections is one of the important skills for students in solving problems, in addition to the reasoning skills that have been previously discussed (Sari & Zulkarnaen, 2021). Nurainah et al., (2018) stated that when solving a problem in mathematics, the connection with other materials is not limited to just mathematics topics but also relates to other disciplines and daily life. Therefore, mathematics is not a collection of separate topics but rather interconnected with each other. When students can see the

connections between different mathematical content, they have developed the value of mathematics as an integrated whole (NCTM, 2009). Galbraith et al., (2017) states that through mathematical connections, students can recognize and apply mathematics to contexts beyond mathematics itself and relate ideas within mathematics. The ability to make mathematical connections will make students' understanding more meaningful. Marshman (2014) states that learning becomes meaningful when students are able to connect and find patterns related to the knowledge they already possess. NCTM also supports this statement by expressing that "when students can connect mathematical ideas, their understanding is deeper and more lasting." If students have good mathematical connection skills, they will find it easier to understand mathematics because they can relate new ideas, concepts, and procedures to concepts they have already learned. (Maulida et al., 2019). The importance of this lies in the fact that it enables students to develop mathematical connection skills.

Reasoning and mathematical connections are essential skills in solving problems in mathematics education. However, these skills will be in vain without students' confidence in their own abilities. This confidence affects students' learning outcomes (Putridayani & Chotimah, 2020). An individual's belief in their ability to organize and execute the necessary actions to achieve a specific outcome is referred to as self-efficacy. Self-efficacy refers to a person's perception of their own ability to perform a particular action (Schunk & DiBenedetto, 2014). Students with high self-efficacy will be better prepared to face various situations and able to produce positive outcomes in their lives. This aligns with what was stated by Bai & Jing (2020) Self-efficacy determines how people feel, think, motivate themselves, and behave. It will lead students to find positive aspects in their lives.

The importance of self-efficacy in students is partly due to its significant impact on success and failure in solving math problems (Utami & Wutsqa, 2017). Study Koirala (2009) conducted in the United States found that self-efficacy and mathematical performance have a positive correlation. This indicates that as students' self-efficacy increases, their performance also improves. Meanwhile McCoach et al., (2015) expressed that self-efficacy can lead individuals to believe in their ability to overcome obstacles in achieving goals. Several studies previously presented show that students with good self-efficacy will minimize errors when solving math problems. Conversely, students with low self-efficacy will make more mistakes. Based on the description of the importance of reasoning ability, mathematical connections, and self-efficacy, it is evident that these three aspects are still

not adequately addressed in the learning process. Field data shows that students' abilities in reasoning, mathematical connections, and self-efficacy are still low (Mandur et al., 2016; Shodikin, 2015). Based on the research background above, this research aims to describe reasoning abilities, mathematical connections and self-efficacy as well as the difficulties faced in solving opportunity material story problems in each category of reasoning ability, mathematical connections and self-efficacy.

METHODS

The research method used is a survey study with both quantitative and qualitative approaches. The types of occurrences surveyed in this study include students' reasoning abilities, mathematical connections, and self-efficacy, as well as the difficulties faced in solving story problems related to probability, categorized by reasoning ability, mathematical connections, and self-efficacy. This research was conducted at SMP Negeri Sleman Regency during the 2023/2024 academic year in the odd semester. The data collection period for the study was 4 weeks, starting from August 2023 to September 2023. The research was carried out in three stages: Stage 1 involved administering tests on reasoning and mathematical connections related to probability; Stage 2 involved distributing self-efficacy questionnaires; and Stage 3 involved in-depth interviews with several students. Tests and questionnaires were administered to all research subjects, totaling 383 students from 12 SMPNs in Sleman Regency, while in-depth interviews were conducted with subjects representing each category of reasoning, mathematical connections, and self-efficacy. The data analysis techniques used were descriptive statistical techniques aimed at determining the average scores and categories of students' reasoning abilities, mathematical connections, and self-efficacy, and inferential statistical techniques used to estimate the average levels of reasoning abilities, mathematical connections, and self-efficacy.

RESULTS

Description of Students' Mathematical Reasoning Abilities in Solving Story Problems on Probability Material

Based on the test results regarding students' mathematical reasoning ability in solving story problems related to probability, the average scores for each school stratum correspond to

their respective levels. Therefore, the highest average was obtained by the high strata, and the lowest average was obtained by the low strata, which were 72.03 and 53.61 respectively. The average score of the low strata is below the overall average of 59.22. For the highest scores achieved, the high strata obtained the highest score of 92. In contrast, for the lowest scores achieved, the low strata obtained the lowest score of 23.

Meanwhile, based on the indicators of students' mathematical reasoning ability, the highest average indicator is formulating hypotheses or conjectures, with an average score of 2.56 out of a maximum score of 4, representing 64%. This indicates that students are more capable of formulating hypotheses than performing mathematical manipulation, drawing conclusions with logical arguments, and evaluating the validity of arguments. The indicator with the lowest average is evaluating the validity of arguments, with an average score of 2.06 out of a maximum score of 4, representing 51.55%. This indicates that students are still weak or less capable in evaluating the validity of an argument.

Description of Students' Mathematical Connection Abilities in Solving Word Problems on Probability

Based on the test results regarding students' mathematical connection abilities in solving word problems on probability, the average scores vary across different school strata. The highest average score is obtained in the high stratum, which is 74.48, while the lowest average score is obtained in the low stratum, which is 56.06. The average score of the low stratum is below the overall average, which is 61.31. For the highest score achieved, the high stratum obtained the highest score of 92. Meanwhile, for the lowest score achieved, the middle stratum obtained the lowest score of 17.

Meanwhile, based on the mathematical connection indicators, the highest average score is for the indicator of connecting concepts within the same mathematical topic, with an average score of 2.87 out of a maximum score of 4, corresponding to 71.78%. This indicates that students are more capable of connecting concepts within the same mathematical topic than connecting concepts between different mathematical topics and connecting mathematical material with materials from other subject areas. The indicators for connecting concepts between different mathematical topics and for connecting mathematical material with other subject areas both received the same average score of 2.54 out of a maximum score of 4, corresponding to 63.5%.

Description of Student Self-Efficacy in Solving Word Problems on Probability

The student self-efficacy questionnaire was administered to 384 research subjects and consisted of 20 statements, with each item having a score range from 1 to 5. Thus, the total self-efficacy score ranges from 20 to 100. Based on the results, the highest average score was found among students from high-status schools, with a score of 73.05, while the lowest average score was among students from mid-status schools. The highest individual score achieved was 96, from a student in a low-status school, and the lowest score was 40, from a student in a mid-status school.

The data also showed that the most frequently chosen response was "sometimes," with an average percentage of 33.29%, whereas the least chosen response was "never," with an average percentage of 7.45%. Among the 20 statements provided, the "always" response was most frequently selected for statement number 14: "I am confident I can solve math problems if they are similar to the examples given," with 40.9% of respondents choosing this option. The "often" response was most commonly selected for statement number 3: "I look for similar solution examples to solve the given math problems," with 44.79% of respondents.

The "sometimes" response was most frequently selected for statement number 1: "I can find alternative answers when solving the given math problems," with 52.34% of respondents choosing this option. The "rarely" response was most often selected for statement number 6: "I do not complete math problems when they are complicated," with 35.16% of respondents. Lastly, the "never" response was most commonly selected for statement number 2: "I do not seek answers to math problems because they are difficult," with 28.12% of respondents.

Description of Student Difficulties in Solving Story Problems in Probability Material Across Mathematical Reasoning Ability Categories

Based on the results from all junior high school students in Sleman Regency, information was obtained regarding students' performance in solving mathematical reasoning problems. Overall, the majority of students answered correctly but incompletely, with a percentage of 32.59%, while the least common response was not answering, with a percentage of 3.78%. The difficulties and obstacles faced by students led to a variety of errors on the test. In the high and medium strata, students most frequently provided correct but incomplete

answers, with percentages of 39.76% and 35.68% respectively. In contrast, in the low strata, the most common response was incorrect answers, at 34.60%. For the option of not answering, the lowest school strata had the highest percentage, at 4.13%. Consequently, efforts to complete mathematical reasoning tests were more substantial, particularly among students in high strata schools compared to those from medium and low strata schools.

The maximum difficulty score of 1536 represents the total possible score for comprehension, transformation, mathematical process, and conclusion difficulties, derived from multiplying the number of questions by the number of students, i.e., 4 × 384. The total difficulty scores obtained by 384 students for 4 questions in mathematical reasoning were: comprehension difficulty at 881, transformation difficulty at 985, mathematical process difficulty at 1006, and conclusion difficulty at 868. Mathematical process difficulty was the type with the highest difficulty score, whereas conclusion difficulty had the lowest difficulty score.

Description of Students' Difficulties in Solving Story Problems on Probability Material by Category of Mathematical Connection Abilities

Based on the results from all students, information was obtained about students' difficulties in solving problems related to mathematical connection abilities. Overall, the most common issue was answering correctly but incompletely, with a percentage of 29.34%, while the least common issue was not answering at all, with a percentage of 4.95%. The difficulties and obstacles faced by students led to variations in errors made on the test. At the high and medium strata, the highest percentages of students were in answering correctly but incompletely, at 38.54% and 31.60%, respectively. In the low strata, the highest percentage was in answering incorrectly, at 30.95%. For the choice of not answering, the high school strata had the lowest percentage, which is 0%. As a result, the effort to complete the mathematical connection test was greater, especially by students from high-stratum schools compared to students from medium and low-stratum schools.

The maximum difficulty score of 1152 represents the total possible score for difficulties in understanding, transformation, mathematical processes, and concluding, calculated by multiplying the number of test items by the number of students, i.e., 3 × 384. The total difficulty scores obtained by 384 students from 3 test items on mathematical connection abilities were as follows: understanding difficulties amounted to 614, transformation

difficulties to 657, mathematical process difficulties to 702, and concluding difficulties to 489. Mathematical process difficulties were the most significant type of difficulty, while concluding difficulties were the least significant.

Description of Students' Difficulties in Solving Story Problems in Probability Material by Self-Efficacy Categories

Based on the answers from all students in solving 7 story problems related to probability material, the total maximum difficulty score of 2688 is the possible total score for types of difficulties in understanding, transformation, mathematical processes, and drawing conclusions, which is obtained from the multiplication of the number of questions and the number of students, namely 7 × 384. The total difficulty scores obtained by 384 students from the 7 story problems in probability material are as follows: difficulty in understanding is 1397, difficulty in transformation is 1464, difficulty in mathematical processes is 1517, and difficulty in drawing conclusions is 1302. Difficulty in transformation is the type of difficulty with the highest score, while difficulty in drawing conclusions is the type with the lowest score.

The difficulty scores obtained by 68 students with high self-efficacy from the 7 story problems in probability material are: difficulty in understanding is 242, difficulty in transformation is 208, difficulty in mathematical processes is 230, and difficulty in drawing conclusions is 186. The difficulty scores obtained by 262 students with moderate self-efficacy from the 7 story problems in probability material are: difficulty in understanding is 937, difficulty in transformation is 1043, difficulty in mathematical processes is 1084, and difficulty in drawing conclusions is 902. Meanwhile, the difficulty scores obtained by 54 students with low self-efficacy from the 7 story problems in probability material are 218, 213, 203, and 214, respectively. Table 38 below presents the percentage of difficulty scores obtained by students compared to the total possible scores for each self-efficacy category and each type of difficulty.

DISCUSSION

Mathematical Reasoning Ability of Students in Solving Word Problems on Probability Material

The mathematical reasoning ability of students is measured based on four indicators: formulating hypotheses or conjectures, performing mathematical manipulations, drawing conclusions with logical arguments, and evaluating the validity of arguments. The students assessed for their mathematical reasoning abilities come from high-status schools, medium-status schools, and low-status schools. The problems given to the students consist of 4 items designed based on the indicators of mathematical reasoning. The mathematical reasoning ability of students in solving word problems on probability material is derived from the students' answers when solving these word problems.

Based on the students' answers in the low-level mathematical reasoning category, it shows that students with low mathematical reasoning only meet one indicator, which is formulating hypotheses or conjectures. Students are able to state the information given in the problem and what is being asked; however, they are not yet able to draw conclusions with logical arguments and evaluate the validity of the arguments. This statement is consistent with Ardhiyanti et al., (2019) which states that students with low mathematical reasoning cannot estimate the solution process because they are unable to organize information, thus they cannot solve problems and are even unable to evaluate the correctness of the arguments.

Mathematical Connection Ability of Students in Solving Story Problems on Probability Material

The mathematical connection ability of students is measured based on three indicators: connecting concepts or principles within the same mathematical topic, connecting material within a specific mathematical topic with material from other mathematical topics, and connecting mathematical material with content from other fields of study in daily life. The students whose mathematical connection ability is assessed come from high, medium, and low-tier schools. The questions given to students consist of 3 items arranged based on the mathematical connection indicators. The mathematical connection ability of students in solving story problems on probability material is obtained from their answers when completing the story problems.

Based on the students' answers in the low-level mathematical connection category, it is evident that students in the low mathematical connection category only meet one indicator, which is connecting concepts or principles within the same mathematical topic. This statement is consistent with Ramdhani (2016) assertion that students with low mathematical connection ability are those who do not fully understand the relationships between different mathematical topics and the connections between mathematical topics and non-mathematical topics.

Student Self-Efficacy in Solving Mathematics Problems

In this study, student self-efficacy was measured based on three dimensions: level, strength, and generality. Level refers to students' belief in their ability to solve tasks of varying difficulty. Strength refers to the robustness of their belief in their ability to complete tasks. Generality refers to students' belief in their ability to connect one task to another. For the dimension of level, there are two indicators: (1) Belief in their ability to handle difficult tasks and (2) Belief in not wanting to avoid tasks perceived as beyond their capability. For the dimension of strength, there is one indicator: the strength of their belief in continuing to make an effort despite facing difficulties and obstacles. For the dimension of generality, there is one indicator: belief in their ability to connect one task to another. The students whose self-efficacy was measured came from high-status, medium-status, and low-status schools.

The results align with Noviza's (2019) research, which found that subjects with high self-efficacy tend to complete all problems accurately, even if there are some inaccuracies in solving the problems. Subjects with low self-efficacy show similar tendencies to those with high self-efficacy but with weaker belief strength, making them more likely to give up when faced with difficulties and obstacles. Conversely, students with low self-efficacy tend to only solve one problem, but their solutions are often less accurate.

Student Difficulties in Solving Story Problems in Probability Material Based on Categories of Mathematical Reasoning Ability

Difficulties in solving story problems in probability material, based on categories of mathematical reasoning ability, can be observed from students' responses to a test with 4

probability questions. Each question reflects a type of difficulty: understanding, transformation, mathematical processes, and concluding. The test was administered to 384 students from 12 public junior high schools in Sleman Regency, categorized into high, medium, and low strata. The following are the findings regarding the types of difficulties experienced by students based on their mathematical reasoning ability test: (1) Understanding Difficulties. Students experience understanding difficulties when they are unable to interpret the question, misinterpret the key terms of the question, or cannot distinguish between important and unimportant information in the question. Based on the data analysis, overall, students experience an understanding difficulty rate of 57.36%. Students with high mathematical reasoning face an understanding difficulty rate of 51.64%, students with moderate mathematical reasoning face a rate of 57.34%, and students with low mathematical reasoning face a rate of 66.33%. This indicates that students have difficulty understanding the material, particularly in interpreting questions and distinguishing important from unimportant information; (b) Transformation Difficulties. Students experience transformation difficulties when they are unable to convert the problem into the required form or use concepts/formulas that do not match the problem. Based on the data analysis, overall, students experience a transformation difficulty rate of 65.36%. Students with high mathematical reasoning face a transformation difficulty rate of 53.07%, students with moderate mathematical reasoning face a rate of 65.38%, and students with low mathematical reasoning face a rate of 74.83%. In the answer sheets, students only mentioned the possibility of consecutive days for one subject. When the researcher inquired about the possibility of consecutive days mentioned, students did not understand that this possibility represented only one subject. Students did not realize that the number of subjects would affect the number of possible outcomes. They were confused by the number of subjects provided in the question. This shows that students experienced transformation difficulties, as they could not apply the appropriate concept to the problem; (c) Mathematical Process Difficulties. Students experience mathematical process difficulties when they cannot perform calculations correctly or use correct concepts/formulas but fail to complete the problem. Based on the data analysis, overall, students experience a mathematical process difficulty rate of 66.54%. Students with high mathematical reasoning face a mathematical process difficulty rate of 55.59%, students with moderate mathematical reasoning face a rate of 68.63%, and students with low mathematical reasoning face a rate of 72.45%. When students were asked during interviews

about their approach to solving the given math problems, they were unable to answer. This indicates that students experienced mathematical process difficulties, as they could not complete the problem correctly even though the concepts/formulas used were accurate; (d) Conclusion Difficulties. Students experience conclusion difficulties when they are unable to interpret correctly and express mathematical solutions in real-world terms. Based on the data analysis, overall, students experience a conclusion difficulty rate of 56.51%. Students with high mathematical reasoning face a conclusion difficulty rate of 40.46%, students with moderate mathematical reasoning face a rate of 58.78%, and students with low mathematical reasoning face a rate of 69.39%. Based on the interviews conducted, the researcher found that students' answers did not fully address who was correct. This shows that students experienced conclusion difficulties, as they were unable to interpret correctly and completely. This is due to their inability to provide statements that accurately represent the information requested.

Students' Difficulties in Solving Word Problems in Probability Material Based on Mathematical Connection Ability Categories

Difficulties in solving word problems in probability material based on mathematical connection ability categories can be observed from students' responses to a test consisting of 3 questions. Each question reflects types of difficulties related to understanding, transformation, mathematical processes, and drawing conclusions. The test was administered to 384 students from 12 public junior high schools in Sleman Regency with high, medium, and low strata. The following are findings on the types of difficulties students experience in solving problems related to mathematical connection ability: (a) Understanding Difficulties. Students experience understanding difficulties if they are unable to interpret the question, misunderstand the key terms, and fail to distinguish between important and unimportant information in the question. Based on the data analysis, overall, students experienced understanding difficulties at a rate of 53.3%. Students with high mathematical connection ability experienced understanding difficulties at 50%, students with medium mathematical connection ability at 52.65%, and students with low mathematical connection ability at 58.33%. Students with understanding difficulties are indicated by those who misinterpret key terms and fail to differentiate important information from irrelevant information; (b) Transformation Difficulties. Students

experience transformation difficulties if they are unable to convert the problem into the required form and use concepts/formulas that are not appropriate for the problem. Based on the data analysis, overall, students experienced transformation difficulties at a rate of 57.03%. Students with high mathematical connection ability experienced transformation difficulties at 50.83%, students with medium mathematical connection ability at 54.76%, and students with low mathematical connection ability at 70.14%. Students with transformation difficulties are indicated by their use of inappropriate formulas for the problem; (c) Mathematical Process Difficulties. Students experience mathematical process difficulties if they are unable to perform calculations correctly and use correct concepts/formulas but cannot complete the problem correctly. Based on the data analysis, overall, students experienced mathematical process difficulties at a rate of 54.51%. Students with high mathematical connection ability experienced mathematical process difficulties at 53.33%, students with medium mathematical connection ability at 60.58%, and students with low mathematical connection ability at 68.52%. Interviews revealed that students experienced mathematical process difficulties, as evidenced by their correct use of concepts/formulas but inability to complete the problem accurately; (d) Conclusion Difficulties. Students experience conclusion difficulties if they are unable to correctly interpret and express the mathematical solution in real-world terms. Based on the data analysis, overall, students experienced conclusion difficulties at a rate of 48.87%. Students with high mathematical connection ability experienced conclusion difficulties at 27.22%, students with medium mathematical connection ability at 42.33%, and students with low mathematical connection ability at 55.56%. Interviews revealed that students experienced conclusion difficulties, as indicated by their inability to interpret correctly.

Students' Difficulties in Solving Story Problems on Probability Material According to Self-Efficacy Categories

Students' self-efficacy in this study was measured based on the responses to a self-efficacy questionnaire given by the researcher after students completed the story problems on probability material. The self-efficacy questionnaire consists of 20 statements based on three dimensions (level, strength, and generality) and four indicators of self-efficacy. These four indicators are the students' belief in their ability to handle difficult tasks, the belief in not avoiding tasks perceived to be beyond their capabilities, the strength of their belief to

keep trying despite facing difficulties and obstacles, and the belief in their ability to connect one task with another. The response options provided in the questionnaire were always, often, sometimes, rarely, and never. The results of the students' self-efficacy questionnaire were then categorized into three levels: high self-efficacy, moderate self-efficacy, and low self-efficacy, which were subsequently analyzed for the difficulties they faced. The following are the findings of the types of difficulties experienced by students in solving story problems on probability material with high, moderate, and low self-efficacy categories: (a) High Self-Efficacy. Based on the data analysis, students are categorized as having high self-efficacy if they score ≥ 80. Students categorized as having high self-efficacy include 17 students from the high stratum, 12 students from the moderate stratum, and 39 students from the low stratum. The percentage of difficulties faced by students with high self-efficacy is: understanding difficulties 50.84%, transformation difficulties 43.82%, mathematical process difficulties 48.32%, and conclusion difficulties 39.08%. Students with high self-efficacy also experience difficulties in the mathematical process. This is indicated by students using the correct formula but not completing the solution. In terms of transformation and conclusion difficulties, students do not face significant issues as they are able to use the appropriate concepts and provide conclusions. Based on the questionnaire responses, these difficulties occur because students have confidence in their ability to handle difficult tasks and do not wish to avoid tasks perceived as beyond their capabilities, and they continue to strive despite facing difficulties and obstacles. This results in students focusing on solving and obtaining answers to the problems, leading to a slight lack of precision; (b) Moderate Self-Efficacy. Students are categorized as having moderate self-efficacy if they score ≥ 59 or < 80. Students categorized as having moderate self-efficacy include 42 students from the high stratum, 70 students from the moderate stratum, and 150 students from the low stratum. The percentage of difficulties faced by students with moderate self-efficacy is: understanding difficulties 51.09%, transformation difficulties 56.87%, mathematical process difficulties 59.11%, and conclusion difficulties 49.18%. In terms of understanding and conclusion difficulties, these are not too significant as there are only minor errors in word usage and incomplete conclusions. Based on the questionnaire results, these difficulties occur because students are less confident in their abilities when solving math problems that they perceive as complex and different from the problems they usually encounter; (c) Low Self-Efficacy. Students are categorized as having low self-efficacy if they score < 59. Students categorized as having low self-efficacy include 5

students from the high stratum, 14 students from the moderate stratum, and 35 students from the low stratum. The percentage of difficulties faced by students with low self-efficacy is: understanding difficulties 57.67%, transformation difficulties 56.30%, mathematical process difficulties 53.70%, and conclusion difficulties 56.61%. Understanding difficulties faced by students involve difficulties in determining important information from the problems. Students experience transformation difficulties as they are unable to state the formulas or concepts related to the problems. In terms of mathematical processes, students have trouble completing calculations to the end, as shown by incomplete answers in proving each method. Conclusion difficulties involve students being unable to interpret correctly, as evidenced by their inability to determine the final answer to the problems. Based on the questionnaire results, these difficulties occur because students lack strength in their belief to keep trying when facing difficulties, leading them to become easily discouraged and not complete the tasks.

CONCLUSION

Based on the research findings and discussion, the conclusions are as follows: (1) The mathematical reasoning ability of students in solving story problems on probability is categorized as moderate, with an average score ranging from 57.92 to 60.52 within a score range of 0 - 100. The highest average score was obtained in the indicator of making conjectures, while the lowest average score was found in evaluating the validity of arguments; (2) The mathematical connection ability of students in solving story problems on probability is categorized as moderate, with an average score ranging from 59.64 to 62.98 within a score range of 0 - 100. The highest average score was achieved in connecting concepts or principles within the same mathematical topic, while the lowest average score was observed in connecting material within a specific mathematical topic to material from other mathematical topics and connecting mathematical material to material from other subjects; (3) Students' self-efficacy in solving mathematical tasks/problems is categorized as moderate, with an average score ranging from 68.35 to 70.41 within a score range of 0 - 100. The highest average score was found in the belief of not avoiding tasks/problems perceived as beyond their capability, while the lowest average score was in the belief in their ability to relate one task/problem to another; (4) The most dominant to least dominant types of difficulties for students with high mathematical reasoning ability are:

mathematical process difficulties, transformation, understanding, and conclusion. For students with moderate mathematical reasoning ability, the difficulties in descending order are: mathematical process, transformation, conclusion, and understanding. For students with low mathematical reasoning ability, the difficulties are: transformation, mathematical process, conclusion, and understanding; (5) The most dominant to least dominant types of difficulties for students with high and moderate mathematical connection ability are: mathematical process, transformation, understanding, and conclusion. For students with low mathematical connection ability, the difficulties are: transformation, mathematical process, understanding, and conclusion; (6) The most dominant to least dominant types of difficulties for students with high self-efficacy are: understanding, mathematical process, transformation, and conclusion. For students with moderate self-efficacy, the difficulties in descending order are: mathematical process, transformation, understanding, and conclusion. For students with low self-efficacy, the difficulties are: understanding, conclusion, transformation, and mathematical process.

REFFERENCES

Ardhiyanti, E., Sutriyono, S., & Pratama, F. (2019). Deskripsi Kemampuan Penalaran Siswa Dalam Pemecahan Masalah Matematika Pada Materi Aritmatika Sosial. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, *3*(1), 90–103. https://doi.org/https://doi.org/10.31004/cendekia.v3i1.82

Bai, B., & Jing, W. (2020). The role of growth mindset, self-efficacy and intrinsic value in self-regulated learning and English language learning achievements. *Language Teaching Research*, *27*, 136216882093319. https://doi.org/10.1177/1362168820933190

Bieda, K. N., Ji, X., Drwencke, J., & Picard, A. (2014). Reasoning-and-proving opportunities in elementary mathematics textbooks. *International Journal of Educational Research*, *64*, 71–80. https://doi.org/https://doi.org/https://doi.org/10.1016/j.ijer.2013.06.005

Drysdale, M. T. B., & McBeath, M. (2018). Motivation, self-efficacy and learning strategies of university students participating in work-integrated learning. *Journal of Education and Work*, *31*(5–6), 478–488.

Galbraith, P. L., Henn, H. W., & Niss, M. (2017). *Modelling and Applications in Mathematics Education*. Springer US.

Grunner, N. (2020). Difficulties Encountered by High School Students in Mathematics. *International Journal of Educational Methodology*, *6*(4), 703–713.

Hurks, P. P. M., & Loosbroek, E. (2014). Time estimation deficits in childhood mathematics difficulties. *Journal of Learning Disabilities*, *47*(5), 450–461. https://doi.org/https://doi.org/10.1177/0022219412468161

Koirala, L. &. (2009). The Effect of Mathematics Self-efficacy on Mathematics

Achievement of High School Students. *NERA Conference Proceedings 2009*.

Liu, T., Chen, X., Liu, M., Zhang, Y., Xin, T., & Wang, Y. (2020). The effects of children's self-educational aspiration and self-efficacy on mathematics achievement: A moderated chained mediation model. *Anales de Psicologia [Annals of Psychology]*, *36*(2), 262–270. https://doi.org/https://doi.org/10.6018/analesps. 366621

Mandur, K., Sadra, W., & Suparta, I. N. (2016). Kontribusi Kemampuan Koneksi, Kemampuan Representasi, dan Disposisi Matematis terhadap Prestasi Belajar Matematika Siswa SMA Swasta di Kabupaten Manggarai. *Jurnal Pendidikan Dan Kebudayaan Missio*, *8*(1), 65–72. https://doi.org/https://doi.org/10.36928/jpkm.v8i1.84

Marshman, M. (2014). Using concept maps to show "connections" in measurement: An example from the Australian curriculum. *The Australian Mathematics Teacher*, *70*(4), 11–20.

Mata-Pereira, J., & da Ponte, J. P. (2017). Enhancing students' mathematical reasoning in the classroom: teacher actions facilitating generalization and justification. *Educational Studies in Mathematics*, *96*(2), 169–186. https://doi.org/10.1007/s10649-017-9773-4

Maulida, A. R., Suyitno, H., & Asih, T. S. N. (2019). Kemampuan Koneksi Matematis pada pembelejaran CONINCON (constructivism, integrative, and contextual) untuk mengatasi kecemasan siswa. *PRISMA, Prosiding Seminar Nasional Matematika*.

McCoach, D. B., Gable, R. K., & Madura, J. P. (2015). *Instrument development in the affective domain: School and corporate applications (3rd ed.)*. Springer Science.

Mursyida, & Amalia, Y. (2019). Analisis Kesalahan Siswa dalam Menyelesaikan Soal Matematika Peluang Kelas XI SMA Negri 1 Kaway Xvi. *Genta Mulia*, *X*(1), 11–22.

NCTM. (2009). *Focus in high school mathematics: Reasoning and sense making*. National Council of Teacher of Mathematics.

Nurainah, N., Maryanasari, R., & Nurfauziah, P. (2018). Analisis Kesulitan Kemampuan Koneksi Matematis Siswa SMP Kelas VIII Pada Materi Bangun Datar. *Jpmi (Jurnal Pembelajaran Matematika Inovatif)*, *1*(1), 61. https://doi.org/Https://Doi.Org/10.22460/Jpmi.V1i1.P61-68

Putridayani, I. B., & Chotimah, S. (2020). Analisis Kesulitan Siswa dalam Memahami Soal Cerita Matematika pada Materi Peluang. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *3*(60). https://doi.org/https://doi.org/10.22460/jpmi.v3i6.671-678

Riana, R., & Fitrianna, A. Y. (2021). Analisis Kesulitan dalam Menyelesaikan Soal Peluang pada Siswa SMP Kelas IX ditinjau dari Taksonomi Bloom. *JPMI – Jurnal Pembelajaran Matematika Inovatif*, *4*(4), 1019–1032.

Riana, & Zanthy, L. S. (2020). Analisis Kesukaran Pada Materi Peluang Siswa MTs. *Jurnal Pendidikan Matematika APOTEMA*, *6*(1), 80–87.

Rodríguez-Nieto, C. A., & Alsina, Á. (2022). Networking between ethnomathematics, STEAM education, and the globalized approach to analyze mathematical connections in daily practices. *EURASIA Journal of Mathematics Science and Technology Education*, *18*(3), 2–22. https://doi.org/https://doi.org/ 10.29333/ejmste/11710

Rodríguez-Nieto, C. A., Rodríguez-Vásquez, F. M., Font, V., & Morales-Carballo, A. (2021). A view from the TAC-EOS network on the role of mathematical connections in understanding the derivative. *Revemop*, 1–32.

https://doi.org/https://doi.org/10.33532/revemop.e202115

Sari, A., & Zulkarnaen, R. (2021). Analisis Kemampuan Koneksi Matematis Berdasarkan Teori Kastolan pada Siswa Kelas IX. *Jurnal Penelitian Pendidikan Dan Pengajaran Matematika*, *8*(1), 55–62.

Schunk, D. H., & DiBenedetto, M. K. (2014). Academic self-efficacy. In M. J. Furlong, R. Gilman, & E. S. Huebner (Eds.). *Handbook of Positive Psychology in Schools*, 115–130.

Shodikin, A. (2015). Interaksi Kemampuan Awal Matematis Siswa dan Pembelajaran dengan Strategi Abduktif-Deduktif terhadap Peningkatan Kemampuan Penalaran dan Disposisi Matematis Siswa. *Jurnal Inovasi Pendidikan Dan Pembelajaran Matematika*, *1*(1).

Sholeha, V., Risnawati, R., & Habibullah, H. (2021). An Analysis of Student Difficulties in Mathematics Learning in terms of Student Mathematical Connection Ability on Pythagoras Theorem. *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *9*(1), 12–19. https://doi.org/https://doi.org/10.33394/j-ps.v9i1.3510.

Sidenvall, J., Lithner, K., & Jader, J. (2015). Students' Reasoning in Mathematics Textbook Task-Solving. *International Journal of Mathematical Education in Science and Technology*. https://doi.org/https://doi.org/https://doi.org/10.1080/0020739X.2014.992986

Wijaya, A., Retnawati, H., Setyaningrum, W., Aoyama, K., & Sugiman. (2019). Diagnosing Students' Learning Difficulties in The Eyes of Indonesian Mathematics Teachers. *Journal on Mathematics Education*, *10*(3), 357–364.