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Analysis of the Mathematical Ability of Junior High School Students in terms of the Extrovert-Introvert Personality Type

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ABSTRACT

Mathematical abilities that are the basis of mathematical problem solving skills, mathematical communication skills, mathematical reasoning abilities, mathematical connection abilities, mathematical representation abilities. This study aims to describe the mathematical ability of junior high school students in terms of the extrovert-introvert personality type. The results of the study will be used as the main library material in the implementation of the research. This study specifically discusses Carl Gustav Jung's personality type which distinguishes two personality types, namely introverted and extroverted personalities. The type of research used in this study is a literature study research method. The data sources in this study are literature or come from various literatures, including books, journals, newspapers, personal documents and so on. Sources of data used in this study are primary data sources and secondary data sources. Data collection techniques used are Editing, Organizing, and Finding. For data analysis using deductive, inductive, and interpretative. The results of this literature study show: junior high school students with introverted personality types have good mathematical abilities compared to students with extroverted personality types.

Keywords: Mathematical ability, problem solving skills, mathematical communication skill, mathematical reasoning skills, mathematical connection skills, mathematical representation skill, Extrovert-Introvert Personality Type

ABSTRAK

Kemampuan matematis yang menjadi dasar dari kemampuan pemecahan masalah matematis, kemampuan komunikasi matematis, kemampuan penalaran matematis, kemampuan koneksi matematis, kemampuan representasi matematis. Penelitian ini bertujuan untuk mendeskripsikan kemampuan matematika siswa SMP ditinjau dari tipe kepribadian ekstrovert-introvert. Hasil penelitian akan dijadikan bahan pustaka utama dalam pelaksanaan penelitian selanjutnya. Penelitian ini secara khusus membahas tipe kepribadian Carl Gustav Jung yang membedakan dua tipe kepribadian, yaitu kepribadian introvert dan ekstrovert. Jenis penelitian yang digunakan dalam penelitian ini adalah metode penelitian studi kepustakaan. Sumber data dalam penelitian ini adalah literatur atau berasal dari berbagai literatur, antara lain buku, jurnal, surat kabar, dokumen pribadi dan sebagainya. Sumber data yang digunakan dalam penelitian ini adalah sumber data primer dan sumber data sekunder. Teknik pengumpulan data yang digunakan adalah Editing, Organizing, dan Finding. Untuk analisis data menggunakan deduktif, induktif, dan interpretatif. Hasil studi pustaka ini menunjukkan: siswa SMP dengan tipe kepribadian



introvert memiliki kemampuan matematika yang baik dibandingkan siswa dengan tipe kepribadian ekstrovert.

Kata Kunci: Kemampuan matematika, kemampuan pemecahan masalah, kemampuan komunikasi matematis, kemampuan penalaran matematis, kemampuan koneksi matematis, kemampuan representasi matematis, Tipe Kepribadian Ekstrovert-Introvert

25 INTRODUCTION

Mathematics is one element that has an important role in education. It's no wonder that mathematics is a subject that is given at all levels of education, from basic education to higher education. The development of mathematics in Indonesia can be seen through its achievements from the role of Indonesia following international research, Trends in International Mathematics and Science Study (TIMSS) as well as can be seen also on Program for International Student Assessment (PISA) Standards Agency, Curriculum Ministry of Education, Culture, Research, (2022). NCTM (2000) states that the competencies developed in mathematics include problem solving, communication, reasoning, connections, and representation skills.

Problem solving ability is a competency in the mathematics curriculum that must be possessed by students (Ibrahim et al., 2021; Turyanto et al., 2019; Widodo, 2017; Widodo et al., 2018; Widodo et al., 2020). Through problem solving activities, important aspects of learning mathematics can be developed properly. Learning mathematics means learning to solve problems, both problems related to everyday problems and solving math problems itself (Fisher et al., 2021). Problem solving ability is one of the important reasons and becomes one of the basic skills of a person in solving mathematical problems because: (1) problem solving cannot be separated in everyday life, (2) problem solving skills can be used to provide solutions or answers to problems faced is more analytical so that one can become a problem solver (Widodo et al., 2018).

According to Walle (2007), mathematical communication skills are a way of sharing ideas that are more concerned with the ability to speak, write, draw and explain mathematical concepts. This ability gives students the opportunity to explore ideas or ideas and then communicate them to others orally or in writing. By communicating, students learn to use the language of mathematics. In NCTM (2000) mathematical reasoning ability is one of the abilities that students are expected to have in studying mathematics and is the foundation for understanding and doing mathematics.

Mathematics learning must elaborate on several aspects including aspects of critical thinking and problem solving intended so that students can reason effectively. They think systematically, understand that the parts interact with each other. In line with some opinions about reasoning Fisher et al. (2019) suggests that reasoning is the core of mathematics, good reasoning ability will describe mathematical ability. In line with the opinion of Arini & Rosyidi, (2016) which states that reasoning ability is one of the important thinking activities in solving problems.

Connection ability is one of the most important higher order thinking skills and must be developed because in learning mathematics every concept is related to one another. In solving math problems, students only learn what is taught by the teacher without finding out from other sources. The thing that can be done to be able to master mathematical connection skills is that students are

able to link mathematical ideas with understanding between topics in mathematics (Septian et al., 2020).

Representation ability is the ability of students to communicate mathematical ideas/ideas learned in a certain way. The various representations that are often used in communicating mathematical ideas include: diagrams (pictures) or presentations of concrete objects, chart tables, mathematical statements, written text, or a combination of all of them. Representations can be expressed as internal and external (Rahmi, 2002).

One of the internal factors that affect students' mathematical ability is motivation and potential. Potential is a factor that students have that is closely related to their personality. The potential in students can be in the form of different personalities which can affect different thinking processes. The thought process will be related to the direction of psychic energy or the personality of the student. Jung suggested two personalities, namely extrovert and introvert personality. Based on research conducted by Burtăverde & Mihăilă (2011) regarding the significant differences between extroverts and introverts towards simple reactions to conflict situations, it is concluded that introverted individuals who are focused and afraid of failure make them more careful, make fewer mistakes, but require more time longer to think. On the other hand, extroverts respond more quickly but are prone to errors because they focus more on the environment and not on themselves. Extroverts' ability to concentrate is lower than introverts.

Hardini & Puspitasari (2012) suggested that a teacher must pay attention to the characteristics of students in the selection of appropriate learning strategies (including approaches, models, methods and specific learning techniques). Many factors influence the differences in the characteristics of students, one of which is their personality. In learning, the student's personality affects the learning process. Because each student's personality is different, their way of learning is also different. Based on the results of the explanation, the authors are interested in studying the mathematical abilities of junior high school students in terms of the extrovert-introvert personality type.

METHOD

This research is a descriptive research using literature study with an effort to find appropriate and relevant theoretical references to the issues raised, discussed and found by the authors in the field. Reference theory related to the mathematical ability of students who are extroverted and introverted. The sources of data in this study are literature or come from various literatures, including books, journals, newspapers, personal documents and so on. Sources of data used in this study are primary data sources and secondary data sources. Data collection techniques used are Editing, Organizing, and Finding. For data analysis using deductive, inductive, and interpretative. Researchers examined 12 journal articles and 6 books related to the mathematical ability of extroverted and introverted students. The initial stage in this research is to find several articles, journals, books, or theses that support the variables. In this case, the author analyzes several sources of data regarding mathematical abilities when viewed from the extrovert-introvert personality type, and analyzes data sources regarding online learning methods.

RESULTS AND DISCUSSION

The data collected from the results of the analysis carried out by the author on several data sources found, then the overall data obtained to see the connection of mathematical abilities when viewed from the extrovert-introvert personality type through various models / strategies / learning approaches. Based on the results of a review of literature sources, the results of relevant research are (1) Research written by Putri & Masriyah (2020) entitled, "Profile of Mathematics Problem Solving Ability of Junior High School Students on Quadrilateral Material Judging from the Extrovert-Introvert Personality Type". In this study using a qualitative descriptive method which aims to describe the profile of the mathematical problem solving ability of junior high school students on quadrilateral material that has an extroverted or introverted personality. The research subjects consisted of two grade of VII junior high school students with different mathematical abilities, including one extroverted student and one introverted student. The instruments used are extrovert-introvert personality type test called Myer Briggs Type Indicator (MBTI), math ability test, problem solving test and interview guide. The results showed that: (1) extroverted students were not able to carry out all stages of solving problems, students were only able to understand the problem, but students were not able to make plans, carry out plans, and re-examine and (2) introvert students were able to do all the stages of solving the problem, which include understanding the problem, making plans, carrying out plans, to the stage of re-examining. Then to determine the personality types of students in the extrovert and introvert dimensions, the researchers used the Myer Briggs Type Indicator (MBTI) personality test Myers (1993) In the personality type test questions there are 60 questions, each number has two statements (statement A and statement B) which both have opposite meanings. There are many ways that are expressed by experts regarding the stages of problem solving, one of which is George Polya. According to Polya 1(973) in problem solving there are four phases that a person goes through to solve problems, namely understanding the problem, making plans, carry out the plans, and re-examining. Based on the problem solving steps according to Polya, several indicators can be formulated as Table 1.

Table 1. Steps Indicator of Problem Solving

Steps of Problem Solving	Indicator
Understanding the problem	<ol style="list-style-type: none"> 1. Able to explain what is known and asked in the problem. 2. Able to explain the condition of the question regarding the relationship between the information provided.
Making plans	<ol style="list-style-type: none"> 1. Able to find and select information that will be used to answer the questions correctly. 2. Able to explain the plan of completion that will be carried out to solve the correct problem.
Carry out the plans	<ol style="list-style-type: none"> 1. Able to carry out the completion plan in accordance with the plan that has been made previously. If there is a change in planning, students can return to the previous step, namely making plans. 2. Able to carry out the completion plan with the appropriate concept.
Re-examining	<ol style="list-style-type: none"> 1. Able to re-examine the results obtained to ensure the results are correct or not. 2. Able to draw up a conclusion from the given problem.

Based on the results of research conducted by Putri & Masriyah, (2020) obtained results and discussions regarding the profile of junior high school students' mathematical problem solving abilities on rectangular material **in terms of extrovert and introvert personality types.**

Table 2. **The Mathematical Problem Solving Skills in Quadrilateral Material with Extrovert Personality Type**

Steps of Problem Solving	Subject	
	1	2
Understanding the problem	Qualify	Qualify
Making plans	Unqualified	Qualify
Carry out the plans	Unqualified	Unqualified
Re-examining	Unqualified	Qualify

Based on Table 2 above, **it is** concluded **that** extrovert **students are not able to** carry out problem solving steps properly and correctly. At first students read the questions to understand the problem, then proceed with making planning strategies, implementing plans, then re-examining the results that have been obtained. However, at the step of making planning strategies, **students with this extrovert personality type are not able to make correct solutions, these extrovert students do not pay much attention to the** content of the questions given. Extrovert students are not able to find the information used to answer the question correctly. This is what causes errors in solving the problem so that the results obtained are less precise.

Table 3. The Mathematical Problem Solving skills in Quadrilateral Material with Extrovert Personality Type

Steps of Problem Solving	Subject	
	1	2
Understanding the problem	Qualify	Qualify
Making plans	Qualify	Qualify
Carry out the plans	Qualify	Qualify
Re-examining	Qualify	Qualify

Based on Table 3. **above, it can be** concluded **that students** with introverted personality types are able to carry out problem-solving steps correctly, so that they get results as expected. At first introverted students read the questions to understand the problem from the questions given in a repeated pattern, then proceed with making planning strategies, carrying out plans, and finally re-examining the results that have been obtained as reflection activities.

In the subsequent literature analysis (2) written by Nurdiansyah (2020) it describes the profile of written mathematics communication for junior high school students in solving math problems in terms of **extrovert and introvert personality types.** The subjects of **this study** consisted of one extrovert student (ES) and one introverted student (IS) who had the same gender with equal mathematical abilities. Then the instrument used in this study consisted of two main and supporting instruments. The researcher is the main instrument, while personality questionnaires such as Myers Briggs Type Indicators (MBTI), Mathematical Ability Test (MAT), and Written Mathematics Ability Test (WMAT) are supporting instruments. **This research is a descriptive research with a qualitative approach.** This

research was conducted online at Junior High School at Gresik. Then to find out written mathematics communication, written mathematical communication indicators are needed which are adapted from Asmana (2018) which are presented in table 4 below:

Table 4 Indicators of Written Mathematical Communication

Aspects of WMAT observed	Polya's Steps	Information delivered
Accuracy	1. Understanding the problem	Able to write correctly the things that are known and asked.
	2. Making plans	Expressing images (if any) into language, symbols, ideas, or mathematical models correctly that are relevant to the problem.
	3. Carry out the plans	Able to write down the steps of calculation correctly.
	4. Re-examining	Able to write down the conclusion correctly.
Completeness	1. Understanding the problem	Writing down things that are known and asked on questions is enough to solve the problem.
	2. Making plans	Expressing images (if any) into the language, symbols, ideas, or mathematical models needed is sufficient to solve the problem. Writing down the rules used is sufficient to solve the problem.
	3. Carry out the plans	Writing down the required calculation steps is sufficient to solve the problem.
	4. Re-examining	Able to write down the conclusion correctly.
Fluency	1. Understanding the problem	Write down things that are known and asked with no error correction scribbles
	2. Making plans	Expressing images (if any) into language, symbols. Ideas, or mathematical models with no error correction. Write down the rules with no error-correcting scribbles.
	3. Carry out the plans	Perform calculation steps with no error correction scribbles.
	4. Re-examining	Write down the conclusions with no error correction scribbles.

In the Table 4, the researcher made changes to the written mathematical communication indicators at point c, namely the stage of making plans for each aspect of the TKMT observed was changed, which at first was "making pictures" changed to "stating pictures into language, symbols, ideas, or mathematical models." This is done by researchers because interpreting images into words, symbols, or mathematical models is a form of mathematical communication. This is done because it will not be able to observe the time of working on each stage of problem solving because the answer collection process is carried out at the end, not at each stage. In this study, written mathematical communication between extrovert and introvert subjects has several differences, as presented in Table 5.

Table 5. Differences in Written Mathematical Communication Profiles for Extrovert and Introvert Subjects

Polya's steps	Extrovert's subject	Introvert's subject
Understanding the problem	Write down things that are known and asked accurately, incompletely, and not fluently.	Write down things that are known and asked accurately, completely, but not fluently.
Making plans	Do not state images in language, symbols, ideas, or mathematical models. Write down the rules incompletely, inaccurately, and not fluently.	Stating the picture into an arithmetic sequence and a graded arithmetic sequence accurately, completely, and not fluently. Write down the rules accurately, completely and fluently.
Carry out the plans	Write down the calculation steps completely, inaccurately, and not fluently.	Write down the calculation steps from beginning to end in a coherent, accurate, complete, but not fluent.
Re-examining	Write down a complete conclusion, but not accurately, and not fluently.	Do not write conclusions.

Based on Table 5, it can be seen that the written mathematics communication of introverted students is better than that of extrovert students. This can happen because an introvert in doing something is thought out carefully so that it is done carefully. Meanwhile, an extrovert in doing something, is done quickly even though it is prone to errors. In contrast to the findings of Rohmah, (2021) who conducted research on high school students, the results showed that mathematical communication skills in terms of introverted personality type were able to fulfill 1 indicator, namely the ability to explain ideas, situations, and mathematical relationships in writing. While the extrovert personality type fulfills 2 indicators of mathematical communication skills, namely the ability to express everyday events into mathematical language or symbols and the ability to read mathematical symbols. The advantage of the introverted personality type is that it can explain ideas orally and in writing, the disadvantage is that it is not able to understand the problem of mathematical images and symbols. Extroverts have the advantage of being able to understand mathematical symbols, while the disadvantage is that they do not understand the problem well. In line with these findings, Septiana (2019) conducted a research on high school students, with the title profile of Mathematical Communication and Connection abilities of SMA Negeri 1 Mojolaban students in terms of Introverted and Extroverted Personality. The result of the research is that extroverted students are able to complete 3 indicators of mathematical communication skills while introverted students only have 2 indicators.

Furthermore, in the literature analysis written by Arini & Rosyidi (2016) explaining the profile of the reasoning ability of junior high school students in solving math problems in terms of extrovert and introvert personality types. This research is a qualitative descriptive study using a test-based interview method. The subject of this research is one student with an extrovert personality and one student with an introverted personality with equal mathematical abilities and the same gender. The level of mathematical ability is seen from the results of the Mathematical Ability Test (MAT) given by the researcher. In this study, the researcher is the main instrument, while the Mathematical Ability

Test (MAT), personality type questionnaire, reasoning ability test and interview guidelines are supporting instruments. Data collection techniques in this study are by giving personality type questionnaires and test-based interviews. The Reasoning Ability Test (RAT) was carried out with a duration of 75 minutes and the interview was conducted 10 minutes after doing the Reasoning Ability Test. The interviews were conducted alternately. The result of the research is that the mathematical reasoning ability of students with introverted personality types has more control over indicators of mathematical reasoning ability than introverted students. This opinion is in line with the results of (Ahmad et al., 2010; Aziz, 2017) which suggests that students' mathematical reasoning abilities in solving mathematical problems show significant differences between extroverted students. Introverted students show better results than introverted students.

Based on the results of research by Arini & Rosyidi (2016), it can be concluded that students with extrovert personalities are able to find information in the problem but are unable to use the relationship between the information. The allegation made by the extrovert subject is based on a logical reason but the assumption is less precise than the information that is ignored. Overall, the error experienced by extrovert students is that information is ignored. It can be said that these extrovert students are less thorough in investigating the problems given. Meanwhile, students with introverted personalities are able to find and use the interrelationships between the information in the problem. The assumptions made by introverted students are based on logical reasons, namely by looking at the regularities that describe the characteristics of the problems being investigated. In evaluating an argument, this introverted student is very careful to examine every available solution step and examine its correctness by doing calculations in more than one way. In solving problems, introverted subjects are less fast in answering the given problems compared to extrovert students. Most introverted students are calm and think before drawing conclusions.

Surya (2019) explains the description of mathematical connection abilities in class VIII students with extroverted personality types in solving math problems at SMP Muhammadiyah 1 Jambi City. This study aims to describe the mathematical connection ability of extrovert type students in solving mathematical problems on the Pythagorean theorem material. This study focused on extrovert type students, with the reason being that the extrovert group of students was more impulsive (acting suddenly) in solving math problems. Based on the results of his research, it was revealed that the first subject was able to fulfill 2 of 3 indicators of mathematical connection. Subjects are able to recognize and utilize the relationships between ideas in mathematics and are able to recognize and apply mathematics in contexts outside of mathematics. But the subject is not able to understand how the ideas in mathematics are interconnected and underlie each other to produce a coherent wholeness. The subject's mathematical connection ability level is moderate. Then for the second subject, they were not able to meet the mathematical connection abilities for all indicators. Subjects are not able to recognize and utilize the relationships between ideas in mathematics, are unable to understand how ideas in mathematics are interconnected and underlie each other to produce a coherent wholeness, and are unable to recognize and apply mathematics in contexts outside of mathematics.

The level of the subject's mathematical connection ability is classified as very low. Furthermore, for the third subject, it is able to meet 1 of 3 indicators of connection capability. Subjects are able to recognize and apply mathematics in contexts outside of mathematics, Subjects are not able to recognize and utilize the relationships between ideas in mathematics and are unable to understand how ideas in mathematics are interconnected and underlie each other to produce a coherent wholeness. The level of mathematical connection ability of the subject is low. After that, the fourth subject was not able to fulfill the mathematical connection ability for all indicators. Subjects are not able to recognize and utilize the relationships between ideas in mathematics, are unable to understand how ideas in mathematics are interconnected and underlie each other to produce a coherent wholeness, and are unable to recognize and apply mathematics in contexts outside of mathematics. The level of the subject's mathematical connection ability is classified as very low.

In the next literature analysis written by Syafitri et al., (2021) explaining the analysis of the difficulty of mathematical representation abilities of extrovert students in solving math problems on algebra material. This research is a descriptive qualitative research type. The data sources in this study were students of class VII-D Junior High School Jambi City in the even semester of the 2019/2020 academic year. Class selection in this study was based on the results of considerations and input from homeroom teachers and subject teachers. The consideration is that most of the students in this class get math test scores for algebra material below the average, so that the class is believed to have students who can help researchers in the research process. In this study, unstructured interviews were used. Unstructured interviews are free interviews in which the researcher does not use interview guidelines that have been systematically and completely structured for data collection. Representational ability measured in this study includes 3 aspects, namely visual representation aspects, aspects of representation of mathematical equations or expressions and aspects of representation of words or written texts. Based on the results of research both through the results of written answers and interviews, the four research subjects with extroverted personalities showed different results. The difficulty factors experienced by the subject are included in the non-cognitive learning factors. Meanwhile, in terms of personality, especially the extroverted personality, it also affects the difficulty of mathematical representation skills experienced by the four subjects, because the four subjects are not accustomed to working on individual questions.

CONCLUSION

Based on the results of the research and discussion above, it can be concluded that the students' mathematical abilities (mathematical problemsolving abilities, mathematical communication skills, mathematical reasoning abilities, mathematical connection abilities, representation abilities) who are introverted show better performance with the mathematical abilities of extroverted students to junior high school students.

As for some recommendations from this study, it is necessary to conduct research at the high school level, to determine students' mathematical abilities in terms of introvert-extrovert personalities. This study uses various models/strategies/approaches to achieve students' mathematical abilities, so there needs to be further research, that is knowing the mathematical

abilities of junior high school students in terms of introvert-extrovert personalities, using relevant learning models according to the demands of 21st century learning.

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