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Student Cognitive Performance Level Based on SOLO Taxonomy and Student's Personality Type

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ABSTRACT

This research study aims to analyze the level of cognitive performance of students based on the SOLO Taxonomy in solving mathematics story problems in terms of student's personality type. This study uses descriptive qualitative method. The data analysis technique used is data reduction, data presentation, and conclusions. There are 5 subjects in this study, which is taken from seventh grade junior high school students using purposive sampling technique based on the results of personality type questionnaires. From the results, in one class the dominant personality type is the Extraversion personality, followed by Conscientiousness, Openness, Agreeableness, and Neuroticism. Based on analysis result and the fulfillment of SOLO Taxonomy indicators, students with Openness and Agreeableness personality types can reach multi-structural level with cognitive performance level being able to use some relevant information to solve problems. Conscientiousness type students are able to reach rational level with cognitive performance level who can use some relevant information and its relationship to solve problems. Extraversion students are able to achieve Extended Abstract level with the level of cognitive performance who can relate some relevant information and generalize it to solve problems. Neurotism students are able to reach uni-structural level by only being able to focus on one relevant information and have difficulty to determine problem solving strategies. Therefore, it is obtained that the personality type possessed by students contribute to the level of student's cognitive performance which can be seen from the way students make decisions when working on the given math story problems.

Keywords**:** *Cognitive performance level, SOLO Taxonomy, Personality Type.*

Tingkat Kinerja Kognitif Siswa Berdasarkan Taksonomi SOLO dan Tipe Kepribadian Siswa

ABSTRAK

Studi penelitian ini bertujuan untuk menganalisis tingkat kinerja kognitif siswa berdasarkan Taksonomi SOLO dalam menyelesaikan soal cerita matematika ditinjau dari tipe kepribadian. Metode yang digunakan adalah deskriptif kualitatif. Teknik analisis data yang digunakan adalah analisis data kualitatif meliputi reduksi data, penyajian data, dan kesimpulan. Terdapat 5 subjek dalam peneltian yang diambil dari siswa SMP kelas VII dengan menggunakan teknik purposive sampling berdasarkan hasil angket tipe

kepribadian. Dari hasil angket tipe kepribadian, dalam satu kelas tipe kepribadian yang mendominasi adalah tipe kepribadian Extravertion, diikuti tipe Conscientiousness, Openness, Agreeableness, dan Neurotism. Berdasarkan hasil analisis dan keterpenuhan indikator Taksonomi SOLO, siswa bertipe kepribadian Openness dan Agreeableness dapat mencapai tingkat multistruktural dengan tingkat kinerja kognitif mampu menggunakan beberapa informasi relevan untuk menyelesaikan persoalan. Siswa bertipe Conscientiousness mampu mencapai tingkat rational dengan tingkat kinerja kognitif mampu menggunakan beberapa informasi relevan dan hubungannya untuk menyelesaikan persoalan. Siswa Extravertion mampu memencapai tingkat Extended Abstract dengan tingkat kinerja kognitif mampu menghubungkan informasi-informasi relevan dan menggeneralisasikannya untuk menyelesaikan persoalan. Untuk siswa Neurotism mampu memencapai tingkat unistruktural dengan hanya mampu focus pada satu informasi relevan dan kesulitan menentukan strategi penyelesaian soal. Dengan demikian, diperoleh bahwa tipe kepribadian yang dimiliki siswa memberikan kontribusi pada tingkat kinerja kognitif siswa yang terlihat dari cara siswa mengambil keputusan saat mengerjakan soal cerita matematika yang diberikan.

Kata Kunci**:** *Tingkat Kinerja Kognitif, Taksonomi SOLO, Tipe Kepribadian*.

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1. Introduction

Since the end of 2019, both Indonesia and the world are still busy with the problem of the Corona Virus Disease 2019 (COVID-19) pandemic which continues to mutate. As a result, the entire learning process, especially in Indonesia, has been shifted to online learning. Online learning has been implemented since the publication of the decision on the Guidelines for Organizing Learning during the Pandemic (Covid-19) which states that learning can be carried out in two ways, namely limited face-to-face learning (PTM) while still implementing health protocols and distance learning (online). The choice of learning techniques is based on the decision of the student's parents, school policy, and local government policy (Kemendikbud, 2021). For educational units located in the yellow, orange and red zones, it is recommended to carry out collaborative PTM and online learning processes to prevent the emergence of Covid-19 virus new clusters. With these regulations and the status of most regions in Indonesia which are still in the orange – red zone, online learning still dominates in most regions.

Online learning for educators has several impacts, such as educators find it difficult to know the extent of students' understanding and abilities, difficult to know students' characters, and difficult to supervise students during learning. When learning is taking place, when asked students often answer that they understand even though they don't understand, tend to be passive, and are difficult to work with (Arum, 2021; Astuti, 2023). This will make it difficult for educators to know students' abilities and organize learning according to students' abilities so that educators will treat all students the same. If all students' abilities are considered the same, then students with less abilities will have difficulties and complain. Thus, student learning outcomes and learning achievements will be affected.

Learning outcomes can be divided into three dimensions, they are the dimensions of knowledge, attitudes, and skills. For the knowledge dimension, Indonesia refers to the SOLO Taxonomy (Structure of Observed Learning Outcome) by Biggs and Collin as a reference for

grouping Competency Levels in the knowledge aspect (BSNP, 2021). Biggs and Collis (1982) explained that each cognitive stage of students there is the same response and increase from simple to abstract which is divided into five levels of the SOLO Taxonomy as follows.

a. Pre-structural. Students cannot solve the questions given or do not provide a response. If they respond, the response given is not relevant to the information provided.
b. Uni-structural. Students respond by selecting one piece of information from the question and focusing on that information only, making it difficult to use strategies. Students can solve problems with conclusions that are still simple or inaccurate.
c. Multi-structural. Students can solve the questions. Students use some relevant information from the questions, but the information used is not interconnected so they cannot connect the information into a single piece of information that supports solving the questions.
d. Rational. Students can solve questions with some information. Students can look for relationships between several pieces of information that are used to obtain solutions.
e. Extended Abstract. Students can solve questions and reach the right conclusions. Students are able to create a hypothesis, make generalizations, relate information, and produce general principles from data so that they can be applied to new situations.

Each level describes the level of students' cognitive performance in absorbing and understanding knowledge. Each student has a different level of cognitive performance, especially in learning mathematics. In mathematics learning, the understanding that students absorb is different from one another. This can be detected when students solve a mathematical problem. Therefore, it is important to know the level of students' cognitive performance so that students' deficiencies can be identified, students' learning progress can be determined, and students' cognitive abilities can be mapped by educators so that they can organize learning that will be able to maximize students' knowledge domains.

Apart from differences in students' understanding, several studies found that students experienced difficulties when solving problems in the form of mathematics story problems (Farhan & Jumardi, 2023). This is supported by the recognition by several mathematics teachers that story questions form still become an obstacle, students find it difficult to understand the content of the problems presented in the story questions. Solving math story problems requires an ability to reason, analyze and read to obtain a solution (Khasanah, 2015). According to Widyaningrum (2016), story questions are known as disguised questions because they can contain information that is presented explicitly or implicitly so that solving them requires good reading skills to understand what information is known from the question, what is asked about from the question, the relevant information needed so they can decide on the relevant procedures to solve the problem.

In interpreting and solving story problems, students have different abilities. Differences in ability can be influenced by differences in personality types that students have regarding the surrounding environment and the way someone make decisions (Apriyani, 2014; Kamilia et al., 2018; Dhliwayo & Coetszee, 2020). The way students make decisions is what is needed when solving word problems in determining the solution procedure. However, in learning practice, personality factors tend not to be considered. In addition, some studies still tend to focus on the results of the solutions given by students, even though students' understanding in absorbing information from questions is important and needs to be paid attention to. A person's personality type is divided into variations based on certain traits and points of view. In this case, a study state that there is a personality type which is stable and universal enough so that it could be a good predictor for determining a person's performance, namely the Big Five personality types (Caprara et al, 1993; Hemyari et al., 2013; Febiyanti, 2020). According to Lewis R Goldberd,

the Big Five personality types are divided into five types, namely Neuroticsm, Openness, Extraversion, Conscientiousness, and Agreeableness (Nugroho, 2019). Based on this description, researchers are interested in conducting a study regarding the level of student performance when working on mathematics story problems in terms of Big Five personality types.

2. Method

This research uses a descriptive method with a qualitative approach. In general, this research is divided into four processes, namely selecting subjects, giving mathematics tests and interviews, analyzing test and interview results, and writing the results of the analysis into description form. In selecting subjects, the subjects in the research were taken from class VII of junior high school students using purposive sampling techniques. Students are first given a personality type questionnaire based on the Big Five Personalities by IPIP-FFI. Then the questionnaire are analyzed to obtain data on the personality type of each student. From the personality type results obtained, there will be a students taken from each personality type, then there are 5 students were obtained as research subjects based on the subject teacher's suggestions and consideration of students who could communicate their ideas.

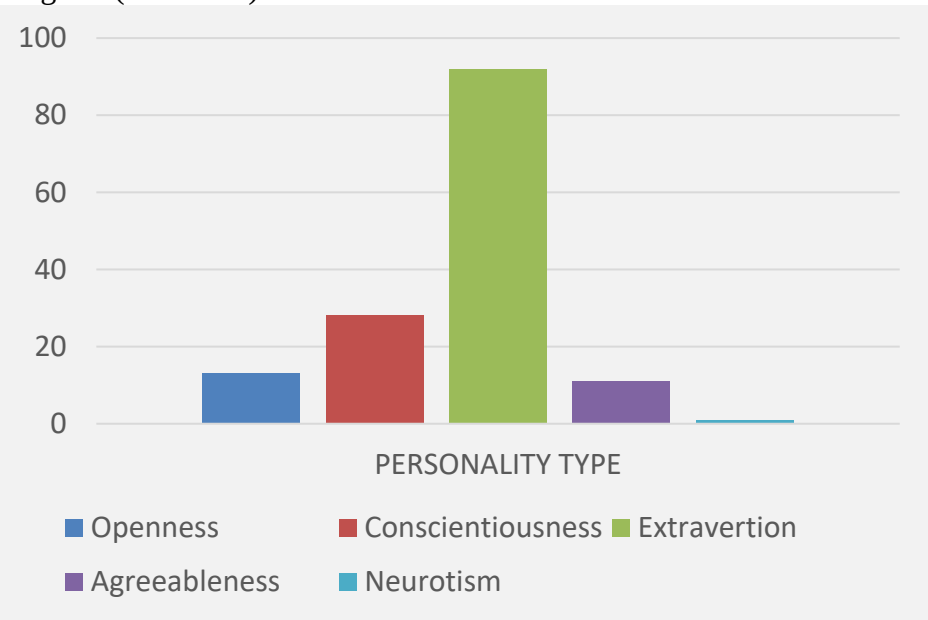
The data collection technique was carried out in two stages, including analysis of student performance levels through written tests and interviews. The written test given consists of 8 questions representing each level of the SOLO taxonomy starting from Unistructural to Extended Abstract (Febiyanti, 2020). The test response results obtained then analyzed based on the fulfillment of the indicators in the SOLO Taxonomy that had been prepared. The results of the analysis of student responses were then strengthened by the results of interviews conducted with the subjects. The two results of the analysis are then described to know the level of cognitive performance in terms of the student's personality type. This research was carried out online and supervised via video conference by turning on the camera during the test process. When giving the test, the math story questions used meet the indicators based on the level of cognitive performance in the SOLO Taxonomy.

In this research, the data analysis technique used is qualitative data analysis. Qualitative data analysis is divided into three stages, such as 1) Data reduction, the researcher records the results of interviews, collects documentary data from the subjects, sorts information related to students' abilities in completing mathematics story questions to determine the level of students' cognitive performance, 2) Data presentation, the researcher presents the results data obtained in the form of tables, diagrams, descriptive text and interview transcripts, 3) Drawing conclusions, from the results of the analysis presented then the researcher draws conclusions that describe the level of student cognitive performance and its relationship to the student's personality type. The validity of the data in this research uses triangulation techniques, which means researchers use different data collection techniques to obtain data from the same source. Technical triangulation was carried out using interview and documentation methods.

3 Results and Discussion

In selecting research subjects, from 224 students who were given the questionnaire, there are 145 students who filled out the questionnaire with the results of 13 students (8.97%) classified as the Openness type, 28 students (19.31%) classified as the Conscientiousness type,

92 students (63.45%) classified as the Extraversion type, 11 students (7.59%) classified as the Agreeableness type, and 1 student (0.69%) classified as the Neuroticism type as seen in the following diagram (**Picture 1**).



Picture 1 Student Personality Type Diagram.

From the diagram it can be observed that the personality type most often possessed by students is the Extraversion personality type with a tendency to be sociable, a social stimulator, has lots of friends and high social skills, active in various social activities, assertive, and talks a lot. Meanwhile, the personality type that students have the least is the Neuroticism personality type with a tendency to easily worry about things that may not happen, feel sensitive to other people's opinions, and always be careful when acting. Each personality type has its own tendencies. Therefore, based on the results of identifying students' personality types, one student each representing each personality type was selected to be given tests and interviews related to math story questions about integers and fractions.

3.1 Student's cognitive performance level

Based on the results of written tests and interviews conducted with the subjects, the level of cognitive performance of each subject is described as follows.

3.1.1. Data Analysis of Openness Student (SO)

Subject with the Openness (SO) personality type was able to reach a multistructural level. Based on student answers and interview results, SO student was able to differentiate relevant and irrelevant information in the questions. SO student can think using more than two pieces of information, but still had difficulty finding relationships between several pieces of information to obtain a solution. SO student is less careful when working on questions so they ignore detailed information in the questions and make less precise conclusions. This can be seen in the picture 2 below.

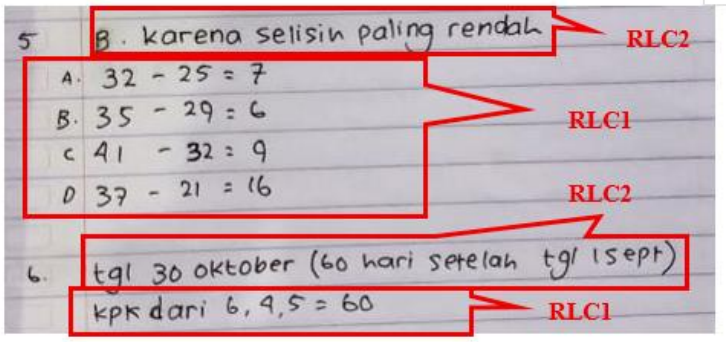
In number 3, student SO did not read the details of the question so that in his answer he lacked steps to change the units of his answer and made the answer given incorrect (MSO2). SO enters a score for "blank" KSN question but SO still given a score (-1) which should be 0 so that the conclusion obtained by SO students is incorrect (MSO2). Thus, in multistructural

level questions, SO students are able to use some relevant information from the questions, but in the process there are some minor errors which resulted in the conclusion being less precise.

Picture 2 SO Student' Answers for number 3 and 4.

3.1.2. Data Analysis of Conscientiousness Student (SC)

Subject with the Conscientiousness (SC) personality type is able to answer test questions up to number 6 which is a Rational level question. Based on student answers and interview results, SC student was able to differentiate relevant and irrelevant information in the questions. SC student can think using more than two pieces of information and look for relationships between several pieces of information to obtain a solution. SC student obtained this relationship from combining the concept of measurement and integer material. For example, in questions number 5 and 6 below.



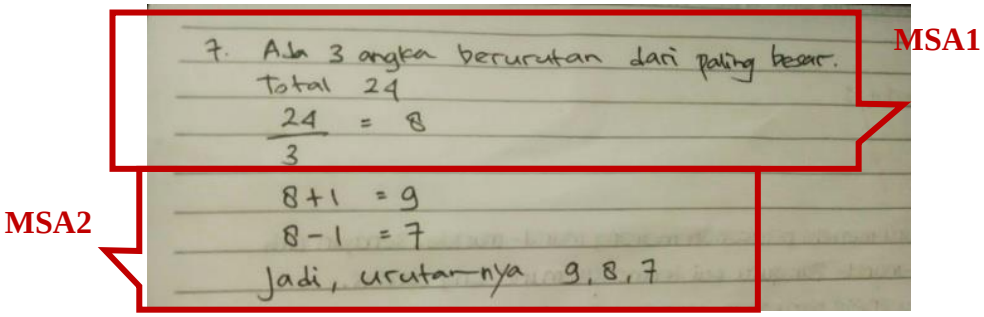
Picture 3 SC Student' Answers for number 5 and 6.

For numbers 5 and 6 SC students are able to use more than one relevant piece of information and able to connect the information obtained with other concepts to solve problems (RLC1 and RLC2). In answer number 5, SC student was able to connect information on the initial temperature of the material before and after burning to get information on temperature changes and decide to choose the lowest temperature change based on the concept of heat in science lessons (RLC2). In (RLC2) for number 6 SC students were also be able to connect the information they obtained from calculating the least common multiple value (KPK) with the calendar concept to get a solution.

3.1.3. Data Analysis of Extraversion Student (SE)

Subject with the Extraversion (SE) personality type was able to answer test questions up to number 8 which is an Extended Abstract level question. Based on student answers and interview results, SE student was able to differentiate relevant and irrelevant information from the questions. SE student can use more than two pieces of information to connect this information

with other concepts to obtain solutions. SE student was also able to think abstractly and produce general principles from data so that they can be applied to new situations as demonstrated by SE below.

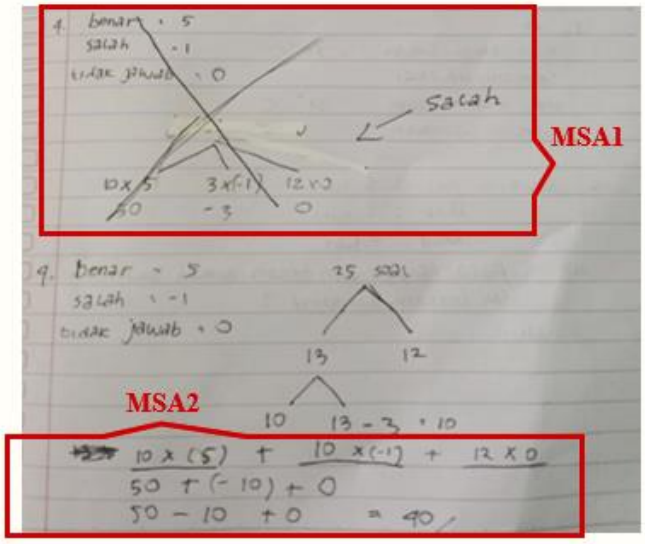


Picture 4 SE Student' Answers for number 7.

In number 7, SE students are able to use information from 3 consecutive numbers to determine one of the numbers and use it as the main benchmark (MSA1). From code MSA2 SE find two other numbers by subtracting them with number 1 or adds them by number 1 and obtain the principle that whatever the total value is, you can find 3 consecutive numbers by finding the whole number in the middle as benchmark (n), while the other two numbers can be found with (n + 1) and (n – 1).

3.1.4. Data Analysis of Agreeableness Student (SA)

Subject with the Agreeableness (SA) personality type was able to answer test questions up to number 4 which are Multistructural level questions. Based on student answers and interview results, SA student was able to differentiate relevant and irrelevant information in the questions. SA student can think using more than two pieces of information, but still have difficulty finding relationships between several pieces of information to obtain a solution. SA student was also easily influenced by other concepts, which influences their answers, which can be seen from the answer in number 4 below.



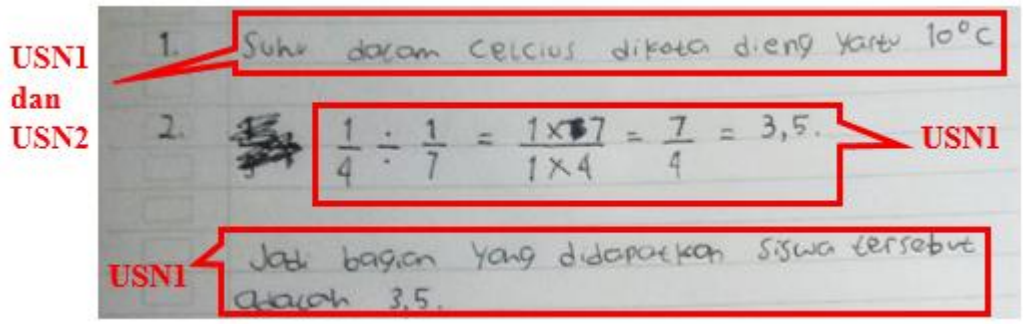
Picture 5 SA Student' Answers for number 4.

In number 4 code MSA1 shown that SA student had calculated correctly, but the SA students suddenly felt doubtful and were influenced by other concepts. In the interview, SA student admitted that they were influenced by the factor tree concept they had just learned, but

when asked whether the factor tree concept was suitable for use and the concept was correct, SA student then became confused and doubted their own answers. In the end (MSA2) SA got distracted and calculate with the wrong information. SA supposed to write that the false is 3 but SA write 10 instead.

3.1.5. Data Analysis of Neuroticism Student (SN)

Subjects with the Neuroticism (SN) personality type are able to reach the Unistructural level. SE student can focus on a piece of information presented in the question, but when there is more than one piece of information in the question, SN student will be confused in determining which information is relevant and which is not relevant. SN student also had difficulty finding a solution strategy because they are too focused on the information they had obtained so that they reach inappropriate conclusions. This can be seen from the answer to number 2 below.



Picture 6 SN Student's answer for number 1 and 2.

In question number 1 and 2, SN student was able to find relevant information correctly to solve the questions (USN1 and USN2). However for number 1, SN only focused on the temperature information on the thermometer and ignored the location of the temperature so that the answer lack of a negative sign (-) which indicates cold temperatures below zero degrees. In number 2, SN student was too focused on the information of 1/4 water in the glass and are confused about solving the questions (USN1). Even SN student used other information that is not written in the questions so that the solutions obtained are less precise. This is in accordance with the opinion of Febiyanti et al., (2020) that student at the unistructural level are not yet be able to plan, create solution strategies, and solve problems well. In addition, a study shows that adolescent with neurotism type tend to have difficulty controlling themselves, resulting in low levels of cognition (Graham & Lachman, 2014).

3.2 Relationship between personality type and student's level of cognitive performance

Table 1. Relationship Between Personality Type and Student's Cognitive Performance Level.

Personality Type	Performance Level	Personality Traits	Relationship Between Personality Type and Student's Cognitive Performance Level
Openness	Multistructural	Have an interest in something new and have a great desire to know and to try something new.	With their high curiosity, it is easy for SO students to determine all the information that is known in the problem, but on the other hand, when working their focus and attention is scattered with the entire content of the story in the problem, making it difficult to connect each piece of information.
Conscientious-ness	Rational	Full of caution in carrying out an action or full of consideration in	SC students always check all information and results of their work to avoid misinformation. SC also connects and considers the steps so that SC is able to

		making a decision, systematically.	explain the settlement process systematically with appropriate reasons.
Extravertion	Extended Abstract	Always comfortable when interacting with other people, easy to socialize, live in groups, firm and not long-winded.	When working on questions, SE focus directly on important information related to solving the problem. When making decisions, SE students directly use every concept they have mastered. After finding the SE solution, SE immediately move on to the next question without correcting the answer. During the interview, SE also explained every work process and ideas he had in detail.
Neurotisme	Unistructural	Often nervous, insecure, temperamental and moody.	When working on questions, SN always check the answers many times and too careful in making decisions as a result SN often run out of time to complete them. SN students also need a long time to think because they are hesitant in determining the relevant information and are afraid that the answer they give is wrong.
Agreeableness	Multistructural	Tolerant, doesn't want to get out of comfort zone, obedient, friendly.	SA is easily influenced by other concepts when making decisions and developing problem solving strategies. As a result, SA becomes hesitant in making decisions and often changes strategies. When asked about the information in the question, SA seemed to read the entire sentence containing the information used in the question and had difficulty explaining the information in his own language.

Apart from the analysis of the level of cognitive performance carried out on each student, during research the researchers also found a relationship between personality type and the level of students' cognitive performance. Based on the results of students' answers, the categories of personality types that students have, and the results of interviews, it can be seen that students' personality types make a contribution when working on math story problems. The following is the relationship between personality type and students' cognitive performance levels in working on math story problems.

From the Table 1 above, it can be seen that the characteristics of each personality type play a role when students work on questions, thereby influencing the level of student cognitive performance. The existence of a relationship between personality type and the level of students' cognitive performance is supported by some research that students' personality types influence behavior, students' actions towards the surrounding environment, and the way students make decisions that occurs during questions solving process (Kamilia et al., 2018; Farhan & Jumardi, 2023; Gifsihartini, 2020; Melinda & Muchtadi, 2023). It is also supported by Maya (2018) and Piechurska-Kuciel (2020) that stated every personality has impact and its can be advantageous for someone if they can control the weakness of every personality thus also can be useful for teacher to provide students the best treatment or teaching method.

4 Conclusion

Based on the results and discussion, it can be concluded that from the results of the Big Five Personality test, the personality type that dominates is the Extraversion personality type with a percentage of 63.45% followed by the Conscientiousness, Openness, Agreeableness and Neuroticism types. Based on the fulfillment of the SOLO Taxonomy indicators in solving mathematics story questions on integers and fractions, it was found that students with the Openness personality type could reach the multistructural level. Conscientiousness type

students are able to reach a rational level. Students with the Extraversion type are able to reach the Extended Abstract level. Students with the Agreeableness type are able to reach the multistructural level and students with the Neuroticism type are able to reach the unistructural level. The research found that the BFP (Big Five Personality) personality type possessed by students contributed to the level of students' cognitive performance. This contribution can be seen from the students' responses and the way they make decisions when working on the math story problems given. In the long term, these findings can be utilized by teachers that when creating or training story questions for students, teachers need to pay attention to student major personalities so that the practice of story questions becomes more effective and students are no longer afraid when they get story questions form.

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