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Stage of Cognitive Mathematics Students Development Based on Piaget's Theory Reviewing from Personality Type

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ABSTRAK

Penelitian ini bertujuan untuk menelaah kesesuaian tahap perkembangan kognitif Piaget ditinjau dari tipe kepribadian terhadap siswa kelas X SMA Wachid Hasyim 2 Taman. Subjek dari penelitian ini adalah siswa sebanyak 25 orang dengan usia antara 12 sampai 16 tahun. Penelitian ini menggunakan instrumen Test of Logical Operations (TLO) dalam matematika dan Tes Myers-Briggs Type Indicator (MBTI). TLO terdiri dari 14 soal dan siswa diberi waktu menjawab semua soal selama 45 menit sedangkan MBTI terdapat 60 pernyataan dan siswa diberi waktu 30 menit untuk memberikan pernyataan yang sesuai dengan kepribadiannya. Hasil penelitian menunjukkan 28,5% siswa ekstrovert pada tahap operasi konkrit awal dan 71,5% pada tahap operasi konkrit akhir. Sedangkan 27,2% siswa introvert pada tahap operasi konkrit awal dan 72,8% pada tahap operasi konkrit akhir. Skor rata-rata TOL Piaget memiliki nilai yang sama pada siswa ekstrovert dan introvert yakni 47 yang artinya rata-rata siswa cenderung pada tahap konkrit akhir. Perbedaan pemahaman antara rata-rata siswa ekstrovert dan introvert pada tipe seration, dimana rata – rata siswa ekstrovert pada pemahaman tinggi sedangkan siswa introvert pada pemahaman cukup.

Kata Kunci: Tahap Perkembangan Kognitif; Teori Piaget; Tipe Kepribadian.

ABSTRACT

This study aims to examine the suitability of Piaget's stage of cognitive development in terms of personality type for class X students of SMA Wachid Hasyim 2 Taman. The subjects of this study were 25 students with ages between 12 to 16 years. This study uses the Test of Logical Operations (TLO) instrument in mathematics and the Myers-Briggs Type Indicator (MBTI) test. The TLO consists of 14 questions and students are given 45 minutes to answer all questions, while the MBTI contains 60 statements and students are given 30 minutes to give statements that match their personality. The results showed that 28.5% of students were extroverted in the early concrete operations stage and 71.5% in the late concrete operations stage. While 27.2% of students were introverted at the initial concrete operation stage and 72.8% at the final concrete operation stage. The average score of Piaget's TOL has the same value for extroverted and introverted students, namely 47, which means that the average student tends to be in the final concrete stage. The difference in understanding between the average extroverted and introverted students in the compatible type, where the average extrovert student has high understanding while introverted students have sufficient understanding.

Keywords: Stages of Cognitive Development; Piaget's Theory; Personality Type.

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1. PENDAHULUAN

Students' cognitive development is the main thing in indicators of the success of the teaching and learning process (Nurhidayah, 2018; Sari, Supriadi, & Putra, 2022). Teachers play an important role in monitoring the level of student development properly (Firdaus, 2018; Afriansyah & Arwadi, 2021). So that teachers can monitor student development properly, it is necessary to study and research on theories of cognitive development. One of the leading theories of cognitive development is the theory of Jean Piaget. Piaget's theory of cognitive development has a great influence in the world of education (Puspitasari et al., 2019; Febrilia, 2019; Rizky & Sritresna, 2021).

Piaget's theory of cognitive development gives meaning to intelligence, knowledge and the relationship between students and the surrounding environment, according to Alon and Daeli (2021). Intelligence is a continuous process to form the necessary structures for constant interaction with the environment (Rokhima & Fitriyani, 2018; Febrianingsih, 2021). The structure formed by intelligence and knowledge is very subjective in infancy, early childhood and becomes objective in early adulthood (Aini & Hidayati, 2017) . The development of ways of thinking from infancy to adulthood includes the sensorimotor period (0-2 years), children at this stage experience their period through movement, maximizing senses and learning object invariance; preoperative (2-6 years), the child starts with motor skills; at the stage of concrete operations (7-12 years), children start with logical thinking, and formal operations (13-17 years), the existence of abstract reasoning (Feldmeier, 2007; Lisnani & Asmaruddin, 2018).

According to Marinda (2014) the formal operational stage is the age range of 11 years and adults. This stage is also known as adolescence. Young people think more abstractly, logically and ideally. The abstract quality of formal operational thinking is evident in verbal problem solving (Santrock, 2008; Mulyo, Sari, & Syarifuddin, 2019; Septiyani, Hartatiana, & Wardani, 2021). Formal reasoning is characterized by the ability to think about abstract ideas, organize ideas, and think about what will happen next (Sarumaha, Putri, & Hartono, 2018; Octaviyunas & Ekayanti, 2019). People in the formal operations stage of the problem can make assumptions or hypotheses (Nst & Rahmi, 2017; Nurfadilah & Afriansyah, 2022).

Education in Indonesia, the level of education that enters the formal operation stage occurs at the junior high and high school levels (Iswara, Darhim, & Juandi, 2021; Sari & Madio, 2021). The selection of high school students (SMA) to measure cognitive development in the operational phase is because according to Ruseffendi (2006), that this formal thinking phase is suitable to be applied to students above grade 9 Junior High School (SMP) or more precisely, students SMA class X, XI, and XII as the research subject. Based on the experience of researchers as teachers in schools, some high school students still have difficulty learning Mathematics. One of the factors that influence students' learning difficulties in mathematics is due to the abstract

characteristics of mathematics (Arofah & Noordyana, 2021; Fadilah & Afriansyah, 2021). It may be difficult for students to understand mathematical material and problems, and they may not yet be in the formal operational stage (Gustiana & Puspitasari, 2021; Rhamdania & Basuki, 2021). As Russefendi (2006) said, there are still high school students and students who have never reached the stage of formal thinking .

The use of Piaget's Logical Operations Test (TOL) as a benchmark for this by referring to 7 patterns of logical reasoning. The reasoning patterns include: classification, logical multiple, compensation, propotionality seration, probality, and Correlation (Leongson & Limjap, 2003). Researchers also want to see the stages of cognitive development in mathematics in terms of personality types, because there are differences in mathematical abilities in each personality category. The tool to determine the student's personality type uses the Myers-Briggs Type Indicator (MBTI) (Stein & Swan, 2019) .

The formulation of the problem is "How is the suitability of the stages of cognitive development of mathematics in class X SMA based on Piaget's theory in terms of personality type?. The purpose of this research is to examine the suitability of the stages of cognitive development of mathematics in class X high school students based on Piaget's theory in terms of personality type.

2. METODE

This research method is an exploratory research with a qualitative approach, which aims to examine the suitability of the stages of cognitive development of mathematics in class X SMA based on Piaget's theory in terms of personality type. The research subjects were 25 students of class X SMA Wachid Hasyim 2 Taman. The focus of the problem in this study is how the appropriateness of the stages of cognitive development of mathematics in class X SMA based on Piaget's theory in terms of personality type.

The research indicator is the suitability of the stages of cognitive mathematical development of class X SMA students based on Piaget's theory in terms of personality type and the variables measured include the scores of the Test of Logical Operations (TLO) and Myers-Briggs Type Indicator (MBTI) instruments. TLO has been tested for validity and reliability by (Leongson & Limjap, 2003). The TLO result data was obtained through a test consisting of 14 questions for 45 minutes which were analyzed descriptively. The researcher rearranged the order of the questions from easy to difficult so that students did not immediately find it difficult to answer the questions at first.

The research was carried out in three stages, namely, the first preparation of the research at this stage the researcher got the data of the students who were the research subjects. Second,

student data retrieval using the Test of Logical Operations (TLO) instrument in mathematics. Third, the collection of personality type data using the Myers-Briggs Type Indicator (MBTI).

The types of TLO questions consist of proportionality, classification, serialization, compensation, logical multiplication, probability, and correlation (Aini & Hidayati, 2017; Purnamasari & Afriansyah, 2021). The data obtained from the Test of Piaget's Logical Operations (TLO) will be assessed for each item using the Schoenfeld assessment score (Leongson & Limjap, 2003) as shown inbelow:

Table 1. TLO Guidelines Scoring

Score	Description
0	Students do not try to complete problem or write down things that do not refer to solving the problem
1	Students make a little effort in the form of sketches, note the necessary relationships, record the necessary data, or explain how to solve the problem
2	Students show understanding of the problem by drawing a picture and trying to solve the problem. Problem solved 50%
3	Students can solve the problem correctly but there is a small error in the completion stage Student
4	Students can solve all problems in the right way, complete and the results are also correct

The TLO score results from students will be grouped based on Piaget's cognitive stage (Leongson & Limjap, 2003)

Table 2. Grouping of Piaget's Cognitive Stages based on the TLO Score

Piaget's Cognitive Stage	Score TLO
Early Concrete Operations Stage	0 – 14
Final Concrete Operations Stage	15 – 28
Early Formal Operations Stage	29 – 42
Final Formal Operations Stage	43 – 56

To analyze student achievement per problem type (7 grouping questions described above), the scores were interpreted qualitatively using Schoenfeld's Scoring Continuum (Leongson & Limjap, 2003) which has been adjusted by the researcher. Namely:

Table 3. The category of students' understanding of the TLO questions

Description	Average Score
Low Understanding	0 – 2.16
Poor Comprehension	2.17 – 4.16
Enough Understanding	4.17 – 6.16
High Comprehension	6.17 – 8

Personality types are also classified only on the focus of Extrovert personality and Introvert personality according to Carl Gustav Jung in (Alon & Daeli, 2021) using the Myers-Briggs Type Indicator (MBTI).

Table 4. Grouping of the results of the MBTI personality type

Personality Type	MBTI
Ekstrovet	ESTJ, ESFJ, ENFJ, ENTJ, ESTP, ESFP, ENFP, ENTP
Introverted	ISTJ ISFJ, INFJ, INTJ, ISTP, ISFP, INFP, INTP

3. RESULT AND DISCUSSION

a. Mapping Piaget's Cognitive Development of Students

Based on the tests carried out, the data presented in the following diagram:

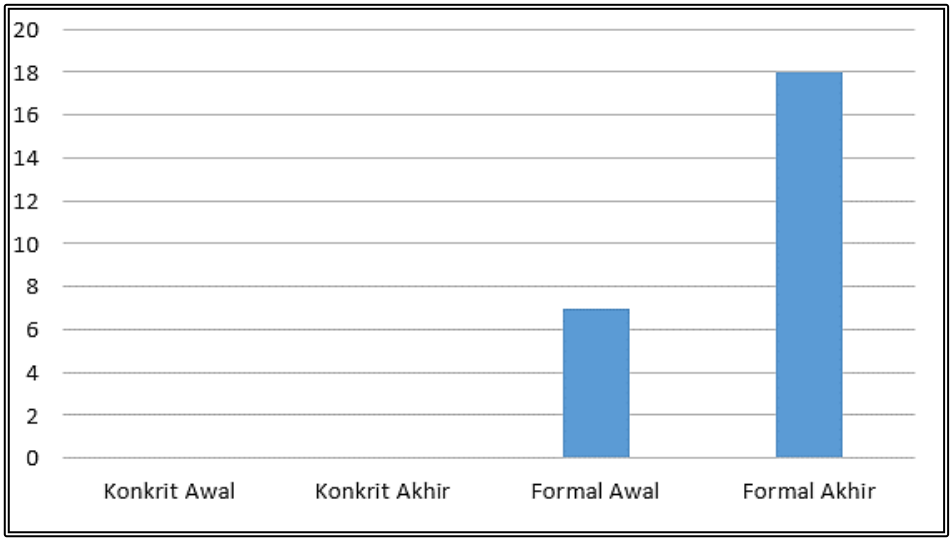

Figure 1. Piaget's Cognitive Development of Students

In Figure 1 shows that students who are in the early formal operational stage are 28%, namely 7 students and at the final formal operational stage are 72 % ie 18 students.

b. Results of Mapping Piaget's Student's Cognitive Development Judging from the Student's Personality Type

From the results of the mapping of student's cognitive development, the division was determined based on personality type. It will be presented in the following diagram:

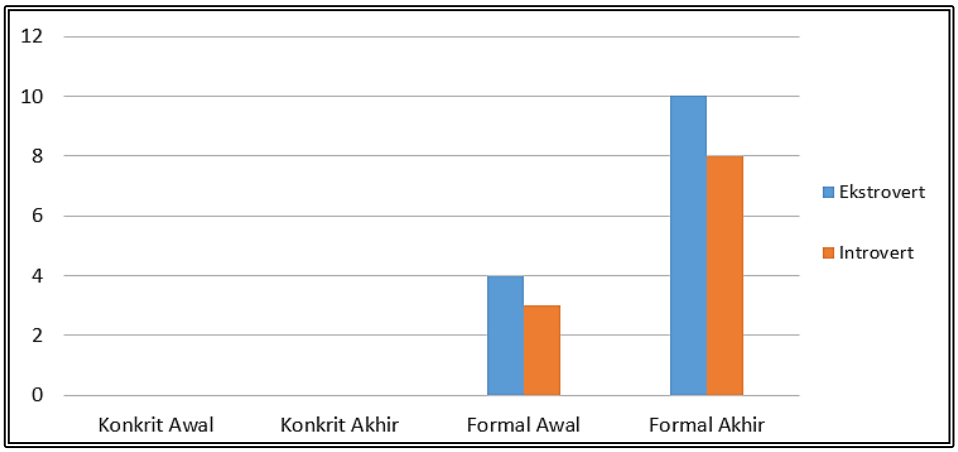

Figure 2. Mapping of Cognitive Development of Extroverted and Introverted Students

In Figure 2 shows that students who are in the early formal operational stage are 4 extroverted students and 3 introverted students, while at the final formal operational stage there are 10 extroverted students and 8 introverted students. Based on the average TLO score, extroverted and introverted students have the same score, which is 47. If categorized in the cognitive development stage, then on average, extroverted and introverted students have entered the final formal operational stage.

c. Results of Mapping Mathematical Understanding in Each Typeand Judging from the Student's Personality Type

Piaget's Logical Operations based on the results of calculations using an adaptation of Schoenfeld's assessment to determine the level of students' understanding of the types of questions on the Test of Piaget's Logical Operations (TLO) obtained:

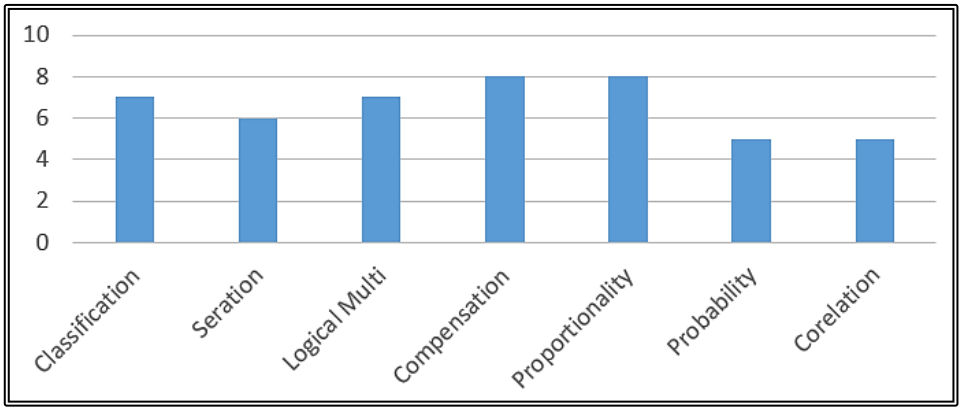

Figure 3. Average Student Understanding

In Figure 3, it can be seen that the understanding is high on the types of classification, logical multiple, compensation, and proportionality, while the understanding is sufficient on the types of harmony, probability, and correlation. Meanwhile, to find the level of students'

understanding of each type in Piaget's logical operations in terms of personality type, it is obtained:

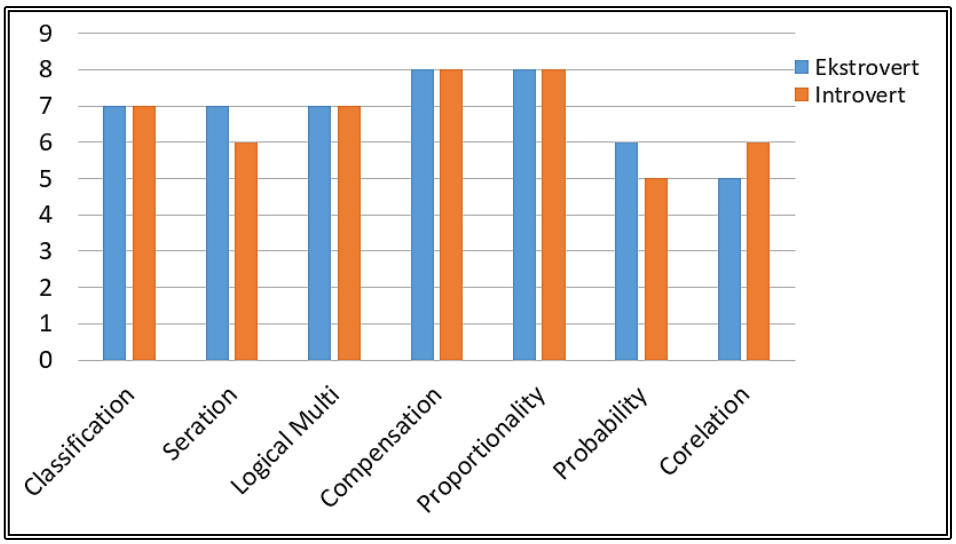

Figure 4. Average Mathematical Understanding

In diagram 4.3 it can be seen that in the types of classification, logical multiple, compensation, proportionality, the average extrovert and introverts show high understanding.on the type probality and Correlation the average - average students extrovert and introvert show enough understanding. The difference in understanding between the average extroverted and introverted students in the compatible type, where the average extrovert student has high understanding while introverted students have sufficient understanding.

4. CONCLUSION

The results of mapping the cognitive development of class X high school students, introverted and extroverted students both get an average Test of Logical Operational (TLO) score of 47. If categorized in the stage of cognitive development Test of Logical Operational, then the average student is extroverted and introverts have entered the final formal operational stage. Therefore, there is no significant difference in the cognitive development of class X high school students towards extrovert and introvert personality types.

The results of the average understanding of extroverted and introverted students also have similarities in the types of classification, logical multiple, compensation, proportionality showing high understanding.on the type probality and Correlation the average - average students extrovert and introvert show enough understanding. The difference in understanding between the average extrovert and introverted students is in thetype harmonious, where the average extrovert student has high understanding while introverted students have sufficient understanding.

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