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Mathematics Reasoning Ability based on Personality Types on *9E* Learning Cycle with *Kid-Friendly Rubrics*

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Abstract

This research aims to describe learners' mathematical reasoning skills based on their personality types on the 9E learning cycle with kid-friendly rubrics. This research is mixed-method with a sequential explanatory design. The data collection of mathematical reasoning skills was done by using a test on four indicators. On the other hand, the data of personality types were taken by using KTS II inventory, documentation, and interview. The research subjects consisted of seventh graders of Private JHS Gema Buwana in 2020/2021. The findings showed that the learners' mathematics reasoning skills with guardian type could explain the model, fact, property, correlation, and pattern. These learners could use the correlation pattern to analyze the situation, create an analogy, and generalize. The artisan type could explain the model, fact, property, correlation, and pattern. They could create assumptions and evidence. The rational type could create a logical conclusion by explaining the model, fact, property, correlation, and pattern. They could also create assumptions and evidence, use the correlation pattern to analyze the situation, create an analogy, or generalize. On the other hand, the idealist type could explain the model, fact, property, correlation, and pattern. They could also make assumptions and evidence.

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INTRODUCTION

Mathematics is a logic-reasoning science and knowledge about logic structure (Luritawaty, 2018). Learners should also master mathematics skills, such as *problem-solving*, communicating, connecting, reasoning, and representing skills (NTCM; Effendi: 2012), (Hidayati (2015). According to Martin and Kashmer in Falach (2016), the reasoning is considered a drawing-conclusion process based on evidence and assumption.

Thus, mathematics reasoning skills are important and have to be mastered by learners. However, the fact showed that learners' mathematics reasoning skills had not gained significant attention, so that they were low, especially for JHS learners.

It could be seen from the PISA result in 2018. The Indonesian learners' mathematics category got lowered than the Pisa result in 2015. The decreasing point was 7, from the average score of 386 to 378 (Kemdikbud, 2019). It meant the mathematics literacy skills, consisting of mathematical reasoning skills of Indonesian learners, also lowered. Several findings supported the results. According to Aprillianti and Zanthy (2019), the mathematical reasoning skills of JHS learners were categorized low.

Based on the preliminary study at Private JHS Germa Buwana in November 2019, generally, the learners had not understood, and they required more reasoning than others. It can be seen from the learners' works. 72.41% of them answered incorrectly.

The learners' reasoning skills were categorized low due to the applied learning at the school. They had not empowered the learners' potentials optimally (Santyasa et al., 2015; Arivina et al., 2017; Kusumawardani et al., 2018).

Duyanto (2011) defines learning quality as achievement levels from the initial learning objectives and includes art lessons. The objective learning achievements occur due to increased knowledge, skill, and attitudes of the learners through the given classroom learning. Danielson (2013) mentions four quality domains to measure the learning quality: *planning and preparation, classroom environment,* instruction, and *professional responsibility.*

On the other hand, two factors influence learning, such as internal and external factors. Internal factor comes from the learning individual. One of the internal factor realizations is the psychological factor (Slameto, 2010). One of the psychological factor realizations is a different personality that influences the reasoning process (Tahmir, Almuddin, & Albar, 2018). On the other hand, external factor comes from the external sides of an individual. One of the realizations is the school factor covering teaching method, school discipline, and curriculum.

Many learners are not aware of their personalities. Thus, it makes them cannot optimally learn, pay attention, and concentrate on mathematics (Yowono, 2010). Jung, an expert figure in the personality field, as quoted by Subrata in Fatmawati (2017), believed that when an individual was aware of his nature and psychological energy direction, he could indirectly realize his thought. Therefore, understanding the internal feeling of an individual will ease an individual's understanding to improve his awareness. Keirsey and Bates (Layyina, 2018) explain four personality categories: *guardian, artisan, rationalist,* and *idealist.* In Masrukan, Susilo, and Pertiwi (2015), David Kersey argues that the categorization is based on the notions of observable differences from an individual through *behaviors.* When an individual wants to figure out what other individual thinks, it could be figured out from the individual's behaviors.

One of the innovative learning models that can develop learners' mathematics reasoning skills is the *9E learning cycle.* This model encourages learners to be active, so their thinking processes could improve their mathematical reasoning skills.

The weaknesses of every learners' mathematics reasoning skill could be found by *kid-friendly rubrics* during the learning process. It had the purpose to minimize and provide direction so that the learning run properly. Ayhan and Türkyılmaz (2015) explain that *rubric* is derived from a Latin word, *Rubra*, meaning "red." Then, it is adopted by English and shifted into "regulation and guideline." It is in line with Ayhan and Song, as Chowdury (2019) quoted, that a rubric could provide more constructive feedback to facilitate learners to identify areas for improvement. Andrade also found that rubric could clarify the learner- task target, help learners develop their learning, and make a transparent and fair assessment. One of the rubrics is *kid-friendly rubrics.*

It makes learners aware of both levels and their achieved criteria. Therefore, they could direct themselves to work and understand the feedback as work comparisons with their determined criteria (Brookhart, 2008).

Based on the explanation, this research aims to describe the mathematics reasoning skills based on personality types on the *9E learning cycle model*

METHOD

This research is *mixed-method* research. According to Cresswell (2013), mixed-method research combines quantitative and qualitative approaches in research activity. Thus, the obtained data will be much complete and comprehensive. On the other hand, the applied strategy is a *sequential explanatory.*

The population of this research consisted of all eighth-graders of Private JHS Gema Buwana in the academic year 2020/2021. The quantitative research stage subjects consisted of eighth graders of Private JHS Gema Buwana in the academic year 2020/2021. The learners from VIII-1 were groped as experimental group learners taught by *9E learning cycle* with *kid-friendly rubrics.* The model stages consisted of *elicitation, engagement, exploration, explanation, echo, elaboration, evaluation, emendation,* and *e-search* (Kaur, 2014).

On the other hand, the control group was from VIII-2 learners. The PBL model taught them. During the learning process, they were asked to post questions and express their arguments, find relevant information from a hidden resource - to allow them to find alternative and different solutions and find the most effective way to solve problems (Ikman *et al.,* 2017). The qualitative research subjects were obtained by purposive sampling. The subjects consisted of eight students. Every two persons were grouped into one personality type (*guardian, artisan, rationalist,* and *idealist*), from VIII-1 learners.

The learning quality in this research consisted of planning, promoting, and assessing stages. The learning quality measurement in the planning stage was done by testing the validity of the learning instrument. The category should be minimally excellent. The second stage was promotion or realization. This stage quality measurement could be seen from the learning process achievement sheet. It should obtain an excellent category minimally. The third stage was the assessment stage. It was seen from the learning effectiveness toward the final problem-solving skill result. Learning would be deemed effective based on the individual completeness test average score and classical requirement, the average and proposition of mathematics reasoning skill completeness on the given model with *kid-friendly rubrics*. They should show better performances of the learners' mathematics reasoning skills than those taught by PBL.

On the other hand, the qualitative stage consisted of four phases: data validity check to determine the data *trustworthiness* by checking technique; data reduction by allowing the researcher to reduce the data based on the targeted objective; and data display plus a conclusion.

RESULTS AND DISCUSSIONS

The learning quality measurement in the planning stage was done by testing the validity of the learning instrument.

Table 1. Learning Instrument Recapitulation

Instrument	Average	Criteria
Syllabus	4.35	Very Excellent
Lesson Plan	4.29	Very Excellent
Teaching Material	4.38	Very Excellent
Worksheet	4.17	Excellent
The KTS II Inventory	4.30	Very Excellent
PSST	4.35	Very Excellent
PAS	4.30	Very Excellent
Interview Guideline	4.42	Very Excellent

Based on the table, the 9E learning cycle instrument's validation result by applying *kid-friendly rubrics* as the assessment media shows that it is valid and can be applied.

The 9E learning cycle's lesson plan with a *kid-friendly rubric* was elaborated from the syllabus with learning syntaxes of the applied learning model with *kid-friendly rubrics.* It had the purpose of creating qualified learning. It is in line with Maimunah, Titi, & Putri (2017). They found that learning instruments had an important role in improving mathematics reasoning skills.

Interesting figures about the materials completed the teaching material. Thus, it could attract learners to actively learn. The teaching material competencies were core competence, basic competence, achievement indicator of the competencies, an example of the problems, and competence test in questions based on mathematics reasoning indicators. The student worksheet consisted of tasks based on the basic competencies and the arranged learning materials based on the syllabus and teaching materials. From the student worksheet, the learners were trained to apply their mathematical reasoning skills. By the trial run, the PSST results were valid and reliable.

The quality measurement on the stage was seen from the process achievement sheet. It should minimally obtain an excellent category. This assessment was done during four-meeting learning processes. Table 2 shows the recapitulation of the learning process achievement assessment.

Table 2. Learning Process Achievement Assessment

The x^{th} meeting	Average	Criteria
1	3.36	Excellent
2	3.96	Excellent
3	4.20	Excellent
4	4.40	Very Excellent

From the table, the learning process achievement assessment obtained an average score of 3.98, with the excellent quality criterion of *9E learning cycle* with a *kid-friendly rubric*.

The learners were also enthusiastic and active in the classroom. They could properly interact during learning. It was in line with Estanto (2010). He found that learning with the *5E learning cycle* model effectively improved learners' mathematics proportional thinking skills. Pitriarti (2019) also found that learning could make learners active to develop their interests and improve their learning outcomes.

The third stage of the research was done by providing PSST and analyzes the results. The test was based on four indicators of mathematical reasoning skills: (1) creating a logical conclusion; (2) explaining the model, fact, property, correlation, or pattern; (3) creating hypothesis and evidence; and (4) using the correlation pattern to analyze the situation, create an analogy, or generalize (Napitupulu, Suryadi, & Kusumah, 2016). Before analyzing the final data, a normality test was conducted. It obtained a significant value of 0.079>0.05. It showed that the final PSST results for both groups had normal distributions. Then, a homogeneity test of the final data was conducted. It obtained a sig score of 0.309>0.05, showing that the control groups' variants were equal to the experimental group. It happened because the data were normally distributed and homogeneous.

Then, a final analysis could be carried out. It covered: (1) average test, the obtained significant value ($\propto$)=0,000<0.05, meaning the average value of the experimental group learners passed the minimum mastery standard, 68; (2) the classical completeness, value of $z_{0,45}$=1,64, and value of z_{count}=1,90. Because $1.90 \geq 1.64$, then the learners' proportions in the *9E learning cycle* model with *kid-friendly rubrics* had surpassed 75%;

(3) the average difference test obtained a significant value = 0.022<0.05. It meant the mathematical reasoning skills of experimental group learners were better than the control group learners taught by PBL; (4) the proportional difference test obtained $z = 1.386$, and $z_{\propto} = z_{0,05} = 0.917$. Because 1.386>0.917, it means the mathematical reasoning skills of the experimental group had a higher proportion than those taught by the PBL model.

It showed that the applied learning model was supported by feedback in the form of *kid-friendly rubrics.* The role of *kid-friendly rubrics* during the learning process was a learner-work assessment. It provided several benefits, such as a more detailed assessment of each assessed aspect and an atmosphere that allowed learners to pay attention to their friends and understand the shared information. The learners had to know what had been shared orally and written while filling the rubrics.

This assessment could motivate learners to improve their skills. On the other hand, *kid-friendly rubrics* had roles in improving the teacher's awareness about the importance of learners' development on each learning process. This finding supported the previous findings, as presented in the previous sections.

Bennet (2016) found that the rubric functioned as an assessment medium. It was effective and reliable to effectively evaluate the learners' performance and understand the learners' learning. Then, Biggs in Panadero & Johnson (2013) found that a rubric for formative assessment could improve learners' learning and direct positive teaching changes.

The achievement of learners' mathematics reasoning skills was described based on their personality types. The personality type categorization from 30 experimental group learners is shown in Table 3.

Table 3. Personality Type-based Categorizations

Personality Types	Numbers of Learners	Percentage (%)
Guardian	17	57
Artisan	5	17
Rationalist	4	13
Idealist	4	13
Total	30	100%

The results of the inventory became the principles to select the research subjects. They wee SE-15 and SE-22, as the *guardian* typed learners; SE-11 and SE-10, as the *artisan* typed learners; SE-17 and SE-19, as the *rationalist* typed learners; and SE-25 and SE-16, as the *idealist* typed learners. Then, every subject was described in terms of his mathematics reasoning skills.

With a strong memory and preference to connect both prior and new materials, the *guardian* typed learners could rewrite the important information, statement, or question. They could present them completely and accurately. Unfortunately, they could not proceed to the drawing conclusion stage.

It is in line with Yuwono (2010). He found that *guardian* typed learners had several features. Before doing the tasks, they required detailed instruction in the first place. This personality type collected the obtained information then they reviewed what problem was mattered in the question. They could explain the model, fact, property, correlation, or pattern. However, they needed more instruction to explain the evidence of the already made hypotheses. They could use the pattern to connect for analyzing the situation, creating analogy, and generalizing.

The *artisan* typed learners preferred to work hard if they were stimulated. They also wanted to work on and find out everything quickly. It made them answering hurriedly and having mistakes on several questions.

This personality type mastered two mathematics reasoning indicators: explaining model, fact, properly, correlation, and pattern by stimulating them; writing and explaining clear hypotheses and evidence. It is in line with Yuwono (2010) and Widyatmoko (2018). They found that *artisan* type learners could write and explain information into mathematics language or symbol. However, they tended to finish everything quickly and hurriedly. It made them committing several mistakes in answering the questions.

The *rational* typed learners preferred individual tasks. Thus, during the learning process, these learners were not affected by the surrounding. They preferred to find the further reference. They also had high intelligence, but they tended to ignore any materials that they considered needless.

These learners could meet four indicators of mathematical reasoning skills. However, they had some mistakes in completing the equation of two linear variables. Those four indicators created a logical conclusion, although it did not detail; explaining the model, fact, property, correlation, or pattern by stimulation; rewriting and explaining clear hypotheses and evidence; using correlation pattern to analyze the situation and create an analogy, and generalization.

It is in line with Yuwono (2010), Widiyatmoko (2018), Dwiningrum, Mardiyana, & Ikrar (2016). They found that *rational* typed learners could catch the abstraction and materials that required high intellectuality. However, they tended to ignore any materials they considered needless or wasting time. Therefore, teachers had to persuade them of the importance of a material to the other materials.

The idealist typed learners could master two indicators: explaining the model, fact, property, correlation, or pattern; and writing and explaining the clear hypotheses and evidence.

This research was expected to find out the learners' mathematics reasoning skill descriptions based on personality types. The teacher would be expected to be aware and could select an appropriate strategy for every student from the results. It would help the teacher improve the learners' mathematics reasoning skills and be aware of each personality type's strengths and weaknesses. Teachers could also remind the learners' weaknesses and use their strengths. Thus, learners could master all mathematics reasoning skill indicators.

CONCLUSION

It could be concluded that the learners' mathematics reasoning skills with guardian type could explain the model, fact, property, correlation, and pattern. These learners could use the correlation pattern to analyze the situation, create an analogy, and generalize. The artisan type could explain the model, fact, property, correlation, and pattern. They could create assumptions and evidence.

The rational type could create a logical conclusion by explaining the model, fact, property, correlation, and pattern. They could also create assumptions and evidence, use the correlation pattern to analyze the situation, create an analogy, or generalize. On the other hand, the idealist type could provide an explanation about the model, fact, property, correlation, and pattern. They could also make assumptions and evidence.

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