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Mathematical Literacy in Terms of Cognitive Style With Pendidikan Matematika Realistik Indonesia Learning Assisted by Google Classroom

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Abstract

This study aims to (1) find out the difference in the mean increase in students' mathematical literacy with Pendidikan Matematika Realistik Indonesia learning assisted by Google Classroom (PMRI-GC learning) and with Scientific learning, and (2) find out the effect of cognitive style on students' mathematical literacy with PMRI-GC learning. The design in this study was experimental designs: true experimental design: pretest-posttest control group design. The population in this study were students of class VIII SMP N 2 Wedi. The samples were determined by random sampling technique and determined that class VIIIA as the experimental class was given PMRI-GC learning and class VIIIB as the control class was given Scientific learning. The results of the study were the mean increase of students' mathematical literacy with PMRI-GC learning is better than students with scientific learning, the mean increase of students' mathematical literacy with PMRI-GC learning is in the medium category, while the mean increase of students' mathematical literacy with Scientific learning is in the low category, and there is an effect of cognitive style on mathematical literacy of students who receive PMRI-GC learning, with an effect of 23%, meaning that cognitive style has an effect of 23% on mathematical literacy.

1. Introduction

Compulsory subjects that students must learn from both primary and secondary education in Indonesia according to article 37 Chapter X contained in the Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System, one of which is mathematics. As is well known that mathematics is a very important science in life, as well as in the development of other sciences. But it is undeniable that students in Indonesia, especially at Junior High School in SMP N 2 Wedi, still have difficulties in mathematics. The report on the results of the national examination of SMP N 2 Wedi from data released by the Education Assessment Center of the Ministry of Education and Culture in 2017, 2018, and 2019 obtained the mean score of mathematics on the computer-based national exam, respectively, which is 55.87; 51.42; and 49.47. The low score of students is inseparable from students' interest in learning mathematics, such as the results of research by Mahdiansyah & Rahmawati (2014), namely the infuence of students interest on students' mathematics score. Among students there are still assumptions that consider mathmematics as a science that is not important to learn because it is not useful or related to students' lives. Today's mathematics learning has been designed in such a way by involving problems students' daily life problems in the form of story questions, so that students can realize the application and direct benefits of mathematics that affect students' interest in learning mathematics. However, based on interviews with eighth grade mathematics teachers at SMP N 2 Wedi, it was found that eighth grade students when working

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on story-shaped problems involving real-life problems still experienced difficulties. This happens because the mathematical literacy of grade VIII students of SMP N 2 Wedi is still relatively low.

The Program for International Students Assessment (PISA) is an international study of reading, mathematics, and science literacy for 15 year old school students. PISA is organized by the Organization for Economic Cooperation and Development (OECD). So far, PISA has been implemented in 2000, 2003, 2006, 2009, 2012, 2015, and most recently 2018. The Organization for Economic Cooperation and Development (2014) wrote for PISA in 2012 the mean score of mathematical literacy that obtained by students in Indonesia is 375, while the mean score of mathematical literacy set by the OECD is 494. The OECD (2016) writes that for PISA 2015 the mean score of mathematical literacy obtained by students in Indonesia is 386, far from the mean score of mathematical literacy obtained by students in Indonesia. determined by the OECD at 490. The OECD (2019a) wrote that for PISA 2018 the mean score of mathematical literacy obtained by students in Indonesia was only 379 of the minimum mean score of mathematical literacy set by the OECD of 489. From the results of PISA for three consecutive periods, it can be concluded that when solving PISA mathematical literacy questions, students in Indonesia still have difficulty, and mathematical literacy in Indonesia can be said to be still relatively low.

Mathematical literacy is an individual's capacity to formulate, employ, and interpret mathematical in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. It assists indiviuals to recognise the role that mathematical plays in the world and to make the well-founded judgements and decisions needed by constructive, engaged, and reflective citizens (OECD, 2019b, p. 75).

To improve the mathematical literacy of grade VIII students of SMP N 2 Wedi, it is necessary to make efforts to assist students in improving their mathematical literacy. One effort that needs to be done is to innovate in learning mathematics. The low mathematical literacy of students cannot be separated from several factors as described by Rahayu et al. (2020) which includes personal, environmental, and instructional factors. Personal factors that affect students' mathematical literacy are the cognitive styles that each student has. Environmental factors include the ability of teachers seen from their understanding of the differences in students' cognitive styles and the media used in learning. Cognitive style is divided into two, namely Field Dependent (FD) and Field Independent (FI). To determine the cognitive style of FD and FI, a cognitive style test called the Group Embedded Figure Test (GEFT) was used. Students who get a GEFT score of less than 12 include students with the FD cognitive style, while students who get a score of more than 12 include students with the FI cognitive style. Herliani & Wardono (2019) argues that cognitive style is a peculiarity of the way a person has in learning, or rather cognitive style is the way a person stores, processes, or uses information to respond to various tasks or problems given to him. Students' cognitive style affects the process of receiving material for each student, resulting in different students' mathematical literacy. Environmental factors include the ability of teachers seen from their understanding of the differences in students' cognitive styles and the media used in learning. So it can be concluded that cognitive style has an effect on mathematical literacy, so it can be considered to know students' cognitive styles when they want to know students' mathematical literacy.

Rahayu et al (2020) further explains the instructional factors include intensity, quality, and teaching methods include learning strategies and approaches. Wardono & Mariani (2019) stated that learning combined with a learning approach called Indonesian Realistic Mathematics Education (PMRI) greatly contributed to indicators of mathematical literacy so that students' mathematical literacy increased, this is also in accordance with the results of research by Elis Fitria Herliani and Wardono in 2019. Rahman (2018) explains that the PMRI approach is an approach that deals with the use of everyday life problems in finding or building mathematics concepts. As described by Wardono et al (2018a) the PMRI approach is an adaptation of the Realistic Mathematics Education (RME) approach developed by Hans Freudhental, PMRI uses the principles of the RME approach, so that the characteristics of the RME approach are used in the PMRI approach. De Lange in 1987 mentioned five characteristics of the RME approach, namely an phenomenological exploration or the use of contexts; the use of models or bridging by vertical instruments; the use of students own; the interactive character of the teaching process or interactivity; and the interwining of various learning strands.

The scientific approach is the recommended approach used by teachers in learning in the 2013 curriculum in Indonesia. The scientific approach is a change from the textual approach used in the previous curriculum. The use of the Scientific approach is intended to provide understanding to students not to

depend on the teacher for information, but information can come from various sources. Nurdyansyah & Fahyuni (2016) by using a scientific approach in learning, it is hoped that students can be motivated to be active in seeking information from various sources and not depend on teachers at school. During the learning process with a scientific approach, it is expected that students will experience learning, namely (1) observing; (2) ask; (3) collect information; (4) associate; and (5) communicating.

Cahyono & Ludwig (2019) revealed that the use of digital technology has considerable potential in supporting teachers to teach mathematics and supporting students in learning mathematics. Smartphones and computers are examples of digital technology that many students already have. Through smartphones and computers, teachers can take advantage of various educational applications or websites as learning media. As explained above, according to Rahayu et al (2020) one of the factors that influence students' mathematical literacy is environmental factors which include the ability of teachers seen from their understanding of differences in students' cognitive styles and the media used in learning. Google Classroom is an application developed by Google that can be used as a learning media which was released on August 12, 2012. Google Classroom can be accessed with smartphone or computer either through the website https://classroom.google.com. or the Google Classroom application. The results of research conducted by Faujiah et al (2020) showed that there was an effect of 69.40% on students' mathematical literacy on the use of Google Classroom in learning mathematics. In other words, there is a significant effect of using Google Classroom in learning on students' mathematical literacy, so that Google Classroom can be used in carrying out learning.

Based on the background of the problem, the formulation of the problem in this study were (1) is there a difference in the mean increase of students' mathematical literacy with PMRI learning assisted by Google Classroom and with Scientific learning and (2) is there an effect of cognitive style on students' mathematical literacy with PMRI learning assisted by Google Classroom. This study aims to (1) find out the difference in the mean increase in students' mathematical literacy with PMRI-GC learning and with Scientific learning and (2) find out the effect of cognitive style on students' mathematical literacy with PMRI-GC learning.

2. Methods

This study used a quantitative approach to the research design, namely experimental designs: true experimental design: pretest-posttest control group design. Sugiyono (2016) explained that the pretest-posttest control group design used two randomly selected classes, then a pretest was given to determine the initial state of the two classes. Pretest results was good if the scores for the two classes were not significantly different. The data collection technique used was a questionnaire. The population in this study were students of class VIII SMP N 2 Wedi for the academic year 2021/2022. Samples were determined by random sampling technique and determined that class VIIIA as the experimental class and class VIIIB as control class. Class VIIIA was given PMRI-GC learning and class VIIIB was given Scientific learning. The data collection technique used was a questionnaire technique. Questionnaire technique was used to obtain validation data by the validator regarding the research instrument used.

The research instruments used were experimental and control class learning devices, mathematical literacy test, and Group Embedded Figure Test (GEFT). Learning devices consisted of syllabus, lesson plan, teaching materials, student worksheet. GEFT has been widely used by many previous studies and is a standard test in America, so it does not need to be tested or developed. The mathematical literacy test consists of an initial mathematical literacy test and a final mathematical literacy test. Before being used for the mathematical literacy test, the questions were tested first in the test class, then an analysis was carried out which included reliability, validity, discriminatory power, and level of difficulty.

Quantitative data analysis included an initial mean similarity test, an mean increase in the mean difference test, and a regression test. The initial mean similarity test was used to determine the mean score of the initial mathematical literacy in the experimental and control classes. The difference test of mean improvement was used to find out the mean increase of students' mathematical literacy with PMRI-GC learning was higher than students with Scientific learning. The regression test was used to determine the effect of students' cognitive style on students' mathematical literacy. Before carrying out these tests, it was

necessary to test for normality and homogeneity to find out that the sample used came from a population that was normally distributed and had the same or homogeneous variance.

The results of the validation of research instruments (learning devices and mathematical literacy tests) carried out by the validator obtained validation results with very good categories for all instruments. The initial and final mathematical literacy tests consisted of 10 questions each, after testing and analyzing, Six questions were obtained that are suitable for use in the initial and final mathematical literacy tests. For normality and homogeneity tests, the initial and final mathematical literacy scores in the experimental and control classes were normally distributed and had the same variance or homogeneous.

3. Results & Discussions

3.1. Results

3.1.1. Initial Mean Similarity Test

The initial mean similarity test used t-test. According to Wardono (2017), the formula for conducting the initial mean similarity test is

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}} \quad (1)$$

Description:

s : the combined standard deviation of the initial mathematical literacy test scores
n_1 : many students take the initial mathematical literacy test in the experimental class
n_2 : many students take the initial mathematical literacy test in the control class
$\bar{x}_1$: the mean score of initial mathematical literacy test in the experimental class
$\bar{x}_2$: the mean score of initial mathematical literacy test in the control class

Testing hypothesis:

$H_0 : \mu_1 = \mu_2$ (the mean score of initial mathematical literacy in the experimental and control classes is the same)

$H_1 : \mu_1 \neq \mu_2$ (the mean score of initial mathematical literacy in the experimental and control classes is not the same)

with μ_1: the mean score of initial mathematical literacy test in the experimental class and μ_2: the mean score of initial mathematical literacy test in the control class

This study uses $\alpha = 5\%$, obtained probability $= 0.975$ and $dk = 40$. Test criteria: if $-2.02 < t < 2.02$, then H_0 is accepted and otherwise. After calculating, it is obtained $t = 1.23$, which lies between -2.02 and 2.02 or $-2.02 < 1.23 < 2.02$ so that H_0 is accepted dan H_1 is rejected. This means that the mean score of initial mathematical literacy in the experimental and control classes is the same.

3.1.2. Mean Increase in the Mean Difference Test

The mean increase in the mean difference test used t-test with the following formula.

$$t = \frac{\bar{x}_{g_1} - \bar{x}_{g_2}}{s\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}} \quad (2)$$

description

s : the combined standard deviation of the gain score for the mathematical literacy test
n_1 : many students take the mathematical literacy test in the experimental class
n_2 : many students take the mathematical literacy test in the control class
$\bar{x}_{g_1}$: the mean score of the increase in the experimental class
$\bar{x}_{g_2}$: the mean score of the increase in the control class

Testing hypotesis:
$H_0 : \mu_{g_1} \leq \mu_{g_2}$ (the mean increase of students' mathematical literacy with PMRI-GC learning is less than or equal to the mean increase of students' mathematical literacy with Scientific learning)
$H_1 : \mu_{g_1} > \mu_{g_2}$ (the mean increase of students' mathematical literacy with PMRI-GC learning is higher than the mean increase of students' mathematical literacy with Scientific learning)
with μ_{g_1}: the mean increase in the experimental class and μ_{g_2}: the mean increase in the control class.

This study uses $\alpha = 5\%$, obtained probability $= 0.95$ and $dk = 40$. Test criteria: if $t \geq 1.68$, then H_0 is accepted and otherwise. After calculating, it is obtained $t = 1.69$, which is $1.69 > 1.68$ so that H_0 is rejected dan H_1 is accepted. This means that the mean increase of students' mathematical literacy with PMRI-GC learning is higher than the mean increase of students' mathematical literacy with Scientific learning.

To find out how much the increase in the mean score both in experimental and control classes, the increase score was calculated using the following formula.

$$(g_E) = \frac{\bar{x}_2 - \bar{x}_1}{100 - \bar{x}_1} \quad (3)$$

description
(g_E) : normalized gain score in the experimental class
$\bar{x}_1$: the mean score of the initial mathmeatical literacy in the experimental/control class
$\bar{x}_2$: the mean score of the final mathmeatical literacy in the experimental/control class

From the calculation obtained the gain score in the experimental class is 0.49 with the medium category, while the gain score in control class is 0.18 with the low category. This means that the mean increase of students' mathematical literacy with PMRI-GC learning is in the medium category, while the mean crease of students' mathematical literacy with Scientific learning is in the low category.

3.1.3. Regression Test

To determine the regression test used, the classical assumption test was previously carried out which included tests for normality, linearity, dan heteroscedasticity. After the classical assumption test was carried out, the results showed that there was no linear relationship between cognitive style dan students' mathematical literacy. So that the regression test used is a non-linear regression test. Non-linear regression test using three models, namely quadratic, cubic, and exponential. Model selected is based on the highest R square and the lowest Std. Error of the Estimate. Calculation with SPSS obtained the following output.

a

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
,469	,220	,134	18,214

The independent variable is Score_GEFT.

b

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
,609	,371	,260	16,835

The independent variable is Score_GEFT.

c

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
,479	,230	,189	,340

The independent variable is Score_GEFT.

Figure 1. (a) summary table on the quadratic model; (b) summary table on the cubic model; (c) summary table on the exponential model

Based on Figure 1, so the exponential model is chosen with R Square is 0.230 and Std. Error of the Estimate is 0.340.

Purnomo (2016) wrote that making decisions is seen in the Coefficients table output with decision making guidelines

If the value of Sig. < 0.05, then $H_0$is rejected and H_1 is accepted. This means that there is an effect of cognitive style on students' mathematical literacy with PMRI-GC learning.

If the value of Sig. > 0.05, then H_0 is accepted and H_1 is rejected. This means that there is no effect of cognitive style on students' mathematical literacy with PMRI-GC learning.

Testing hypothesis:

H_0: there is no effect of cognitive style on students' mathematical literacy with PMRI-GC learning

H_1: there is an effect of cognitive style on students' mathematical literacy with PMRI-GC learning

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Score_GEFT	,045	,019	,479	2,382	,028
(Constant)	47,120	7,171		6,571	,000

The dependent variable is ln(Score_MathLiteracy).

Figure 2. coefficient table on the exponential model

Based on the Coefficient table output obtained a value of Sig. $= 0.028 < 0.05$ so that H_0 is rejected and H_1 is accepted. This means that there is an effect of cognitive style on the mathematical literacy of students who receive PMRI-GC learning. From Figure 1 (c) summary table on the exponential model obtained R Square $= 0.23$ or 23%, this means that cognitive style has an effect on the mathematical literacy of students who receive PMRI-GC learning. The exponential model of non-linear regression equation is $\hat{Y} = be^{ax} = 47.12e^{0.045x}$ for e (Euler's number), which is a rational number with a value of 2.71828182845904.

3.2. Discussion

In the Initial Mean Similarity Test, the results obtained that the mean score of initial mathematical literacy in the experimental and control classes is the same. This means that the results of initial test or pretest is good. This is in line with Sugiyono (2016) regarding the explanation of the experimental designs: true experimental design: pretest-posttest control group design which states that the pretest results are good if the scores for the two classes is not significantly different.

In the mean increase in the mean difference test, the results obtained that the mean increase of students' mathematical literacy with PMRI-GC learning is higher than the mean increase of students' mathematical literacy with Scientific learning. The gain score in the experimental class is 0.49 with the medium category, while the gain score in control class is 0.18 with the low category. This means that the mean increase of students' mathematical literacy with PMRI-GC learning is in the medium category, while the mean crease of students' mathematical literacy with Scientific learning is in the low category. Rahman (2018) explains that the PMRI approach is an approach that deals with the use of everyday life problems in finding or building mathematics concepts. Learning with the PMRI approach will make students active in foinding or building concepts of mathematics material, so that the material learned will last a long time in students' memories and be able to create a memorable and meaningful learning atmosphere for students. Through learning with the PMRI approach, students who are able to understand the concept of a mathematics material well will be able to understand and solve the problems contained in mathematical literacy problems. In addition, the use of everyday problems in the PMRI approach is able to train mathematical literacy, so that if done repeatedly it will be able to improve mathematical literacy of students. In accordance with research Elis Fitria Herliani & Wardono in 2019 and Wardono & Scolatika Mariani in 2019, the results obtained that the use of the PMRI approach in learning can improve mathematical literacy of students. Plus according to Rahayu et al (2020) that Google Classroom has an effect of 69.40% on mathematical literacy, this shows that PMRI-GC learning will make a better contribution than Scientific learning in improving students' mathematical literacy. In line with research of Anik Rosita, Wardono, & Kartono (2018) which obtained the results that students with PMRI learning had higher scores than students with Scientific learning, and the mean increase of students' mathematical literacy with PMRI learning is higher than the mean increase of students' mathematical literacy with Scientific learning.

In the reggresion test obtained that there is an effect of cognitive style on the mathematical literacy of students who receive PMRI-GC learning, R Square $= 0.23$ or 23%, this means that cognitive style has an effect on the mathematical literacy of students who receive PMRI-GC learning by 23% and 77% is influenced by other factors. The exponential model of non-linear regression equation is $\hat{Y} = be^{ax} = 47.12e^{0.045x}$ for e (Euler's number), which is a rational number with a value of 2.71828182845904. Herliani & Wardono (2019) argues that cognitive style is a peculiarity of the way a person has in learning, or rather cognitive style is the way a person stores, processes, or uses information to respond to various tasks or problems given to him. Wijaya (2016) said that students with FI cognitive style would be easier to accept scientific material (mathematics) than students with FD cognitive style. In other words, students with FI cognitive style will needless guidance or assistance during learning than students with FD cognitive style. So that students' cognitive style is very influential on students' mathematical literacy. Students with FI cognitive style will have better mathmeatical literacy than students with FD cognitive style. As evidenced by the results of the final test in the experimental class, students with FI cognitive style have an mean score 0f 80, while students with FD cognitive style have an mean score of 65.59.

4. Conclusion

Based on the description in Results & Discussions, it can be concluded that the mean increase of students' mathematical literacy with PMRI-GC learning is better than students with scientific learning, the mean increase of students' mathematical literacy with PMRI-GC learning is in the medium category, while the mean increase of students' mathematical literacy with Scientific learning is in the low category, and there is an effect of cognitive style on mathematical literacy of students who receive PMRI-GC learning, with an effect of 23%, meaning that cognitive style has an effect of 23% on mathematical literacy.

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