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The Effect of GeoGebra- Assisted Learning Cycle 7e Model and Cognitive Style on the Mathematical Concepts Understanding Ability

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ABSTRACT

This research aimed to investigate the effects of 1) cognitive style on mathematical concepts understanding model; 2) the application of the GeoGebra-assisted Learning Cycle 7e Model on mathematical concepts understanding; 3) the interaction between the learning model group (Learning Cycle 7e Model, GeoGebra-assisted Learning Cycle 7e Model, and conventional learning model) and the cognitive styles on students' mathematical concepts understanding ability. The samples of this research were 90 eighths--grade students of SMPN 8 Metro determined using the cluster random sampling technique. The researchers employed the quasi-experimental design as the research method with tests as data collecting techniques. The two-way ANOVA test was used to find answers to the research questions. Based on the analysis results, it can be concluded that: 1) The application of the Learning Cycle 7e Model assisted by GeoGebra positively influenced students' mathematical concepts understanding; 2) cognitive style did not affect mathematical understanding ability; 3) there was no interaction between the learning model group and the cognitive style group on mathematical concepts understanding. Further researchers can combine the Learning Cycle 7e Model with other media and see students' cognitive styles differences to maintain the smooth learning process in the classroom.

Keywords: *Learning Cycle 7E, Geogebra, cognitive Style, Mathematical Understanding Concept.*

ABSTRAK

Penelitian ini bertujuan untuk melihat pengaruh: 1) gaya kognitif terhadap kemampuan pemahaman konsep matematis; 2) penerapan model pembelajaran cycle 7e menggunakan geogebra terhadap kemampuan pemahaman konsep matematis; 3) interaksi antara kelompok model pembelajaran (model pembelajaran learning cycle 7E, model pembelajaran learning cycle 7E berbantuan geogebra dan model pembelajaran konvensional) dan kelompok gaya kognitif terhadap kemampuan pemahaman konsep matematis siswa. Sampel dalam penelitian ini ialah siswa kelas VIII SMPN 8 Metro yang berjumlah 75 siswa. Sampel diambil dengan menggunakan Teknik acak kelas. Quasi eksperimental design digunakan sebagai metode penelitian ini dengan teknik pengumpulan data menggunakan tes pemahaman konsep dan tes gaya kognitif. Uji two way Anova digunakan untuk mencari jawaban dari tujuan penelitian yang sebelumnya dilakukan uji normalitas dan uji homogenitas. Berdasarkan hasil uji, diperoleh simpulan bahwa: 1) Penerapan model pembelajaran learning cycle 7E dengan geogebra berpengaruh baik terhadap kemampuan pemahaman konsep matematis; 2) gaya kognitif tidak berpengaruh terhadap kemampuan pemahaman matematis; serta 3) tidak adanya interaksi antara kelompok model pembelajaran dan kelompok gaya kognitif terhadap kemampuan pemahaman konsep matematis. Bagi peneliti selanjutnya dapat menggunakan model learning cycle 7E dikombinasikan dengan media-media yang lain, serta dapat melihat perbedaan gaya kognitif siswa untuk keperluan kelancara proses belajar di kelas.

Kata Kunci: Pembelajaran siklus 7E, Geogebra, Gaya Kognitif, Pemahaman Konsep Matematis.

INTRODUCTION

The way we think, communicate, convince the other person and draw conclusions is often based on analogy (Azmi, 2017). The analogy is part of inductive reasoning, where the way to conclude is based on previously known facts. Goswami (2004) reveals that reasoning by analogy is

widely accepted as a core component of human cognition. Analogous reasoning has long been believed to play an essential role in mathematics learning and problem-solving (Genter, Holyoak, & Kokinov, 2001). In addition, Hofstadter (Pearse & Walton, 2011) argues that analogy plays a vital role in problem-solving, decision making, perception, memory, creativity, emotion, explanation, and communication. Analogies in mathematics can help students understand another material by looking for similarities in properties between the material being compared (Kariadinata, 2012). The explanation about the importance of analogy ability illustrates that students' mathematical analogy skills need to be developed in learning activities.

Mathematics is a subject that exists at all levels of the educational curriculum, from elementary school to university and even in everyday life (Fauzi et al., 2020; R. Utami & Endaryono, 2020). Therefore, students must possess good mathematical concepts understanding to face challenges in their daily lives (Fatimah, 2020; Rahmawati, 2019). Optimizing mathematical concepts understanding requires a solution, one of which is the learning models (Pratiwi, 2016; Sekfia et al., 2020; Suryati & Cahyani, 2018). One of the many learning models used is the Learning Cycle 7e Model(Puluhulawa et al., 2020; DN Utami & Aznam, 2020). This learning model was selected because it is student-centred, and the students are allowed to directly conduct the activities during the classroom learning process (Anshori & Syaiful, 2020; Sritresna, 2015). The following are the stages of learning cycle 7e:

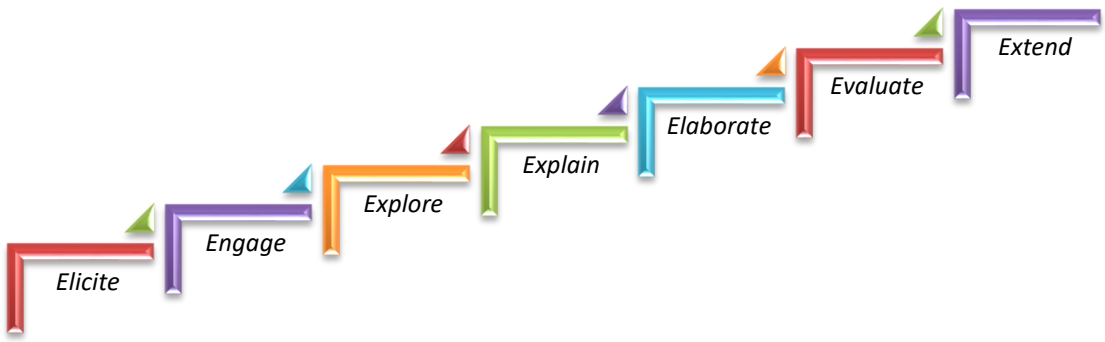

Figure 1. The Stages of the Learning Cycle 7e

Learning models require instruments to support the learning process (Hidayatussani et al., 2020). One of the causes of poor mathematical concept understanding is the lack of instruments (Dazrullisa & Mahdi, 2020; Ulia, 2016). In this research, the learning model was assisted by GeoGebra. GeoGebra is a software that combines geometry and calculus. It can also construct points, vectors, line segments, conic sections, and form fields to construct spatial shapes, even directly determine coordinates, function integrals, and extreme points (Purwanti et al., 2016; Santos & Macedo, 2020; Suryani et al., 2020).

Mathematical concepts understanding can be supported by meaningful learning, where students are required to be active and think creatively in solving problems (Aidah et al., 2020; Yunita et al., 2020). Therefore, students need a learning environment that provides opportunities to develop knowledge through experience and affects the learning process, one of which is cognitive style

(Mawardi et al., 2020). The cognitive style connects intelligence and personality and refers to a person's character in processing, responding, storing, thinking, and using the information in various environmental situations (Nurmala et al., 2019; Ulya, 2015).

A study on the application of the Learning Cycle 7e Model has been carried out by Manurung (2018), who states that the Learning Cycle 7e Model can improve students' critical thinking skills. This learning model can also positively impact students' problem-solving abilities, motivation, and mathematical connections (Darojat, 2016; Nur'aini et al., 2017; Partini et al., 2017; Yenni 2016). Based on this data, research on the effect of the Learning Cycle 7e Modelassisted by GeoGebra on junior high school students' mathematical concepts understanding has not been carried out. Therefore, the researchers were interested in researching this issue. Besides classroom learning, the researchers suspected that other factors influence students' low conceptual understanding, one of which was cognitive style.

Cognitive style is an individual's characteristic in building beliefs about the surrounding world and reacting to the received information (Febriyanti, 2015). Therefore, the teacher should pay attention to the patterns or thinking styles of each student. The patterns or thinking styles differences should become the basis for planning the classroom learning process and selecting learning media. Suryanti (2014) states that cognitive style affects students' learning outcomes. Other studies also mention that cognitive style affects mathematical problem-solving skills (Nurmutia, 2019; Wulandari & Agustika, 2018), appreciation, and achievement (Marlissa & Widjajanti, 2015; YASA et al., 2013). The statement further strengthens the notion that cognitive style will also affect students' concepts understanding.

METHOD

The researchers employed the quasi-experimental design with a quantitative approach. This method was selected because the researchers could not control all the external factors influencing students' concepts understanding. The research design consisted of three groups: experimental group 1, experimental group 2, and control group using a 3 x 2 factorial design.

Table 1. Research Design

Learning Model (Ai)	Cognitive Style (Bj)	
	Field Independent (B1)	Field Dependent (B2)
Learning Cycle 7e Model Model (A1)	A1B1	A1B2
Learning Cycle 7e Model + GeoGebra (A2)	A2B1	A2B2
Conventional Model (A3)	A3B1	A3B2

The population in this research was all eighth-grade students of SMPN 8 Metro in the academic year 2020/2021, which consisted of 396 students distributed into fourteen classes. The samples were determined by cluster random sampling technique, which obtained class VIII-B (29 students) as the control class, class VIII-D (31 students) as the experimental class 1, and class VIII-J (30 students) as the experimental class 2. The total number of samples was 90 students within three classes.

The researchers collected the data using tests that had been tested for their validity and reliability. The researchers also conducted prerequisite tests on the obtained data, which consisted of the normality test using the Liliefors formula and the homogeneity test using the Barlett test. The ANOVA of two unequal cell paths and then double comparison test (advanced test) using Scheffe' method were performed using the SPSS software.

RESULTS AND DISCUSSION

Students' mathematical concepts understanding of the coordinate system material is presented in Table 2.

Table 2. Descriptive Test of Experimental Group 1, Experimental Group 2, and Control Group

Exp 1, Exp 2, control	FI, FD	mean	Std. Deviation	N
Experimental 1	FD	74.31	6,741	18
	FI	75.52	4,178	12
	Total	74.79	5,799	30
Experimental 2	FD	78.47	8,896	18
	FI	76.56	4,711	12
	Total	77.71	7,465	30
Control	FD	61.40	10,878	17
	FI	58,17	10.008	13
	Total	60.00	10,458	30
Total	FD	71.58	11,404	53
	FI	69.76	10,976	37
	Total	70.83	11.204	90

Table 2 shows the average score differences of students' mathematical concept understanding ability between the experimental group 1 (Exp1), experimental group 2 (Exp 2), and control group. Experimental group 2 obtained a higher score than experimental group 1 and the control group. Based on the prerequisite tests, the data met the requirements (normally distributed and homogeneous). Therefore, the researchers performed the hypothesis testing using analysis of variance (ANOVA) of two unequal cell paths assisted by SPSS software version 2.4 at a significant level of 5%.

Table 3. The Results of ANOVA Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5522,316a	5	1104,463	16,422	,000
Intercept	435625,782	1	435625,782	6477,066	,000
Class	5360,104	2	2680,052	39,848	,000
cognitive_style	37,130	1	37,130	,552	,460
interaction	75.488	2	37,744	,561	.573
Error	5649,559	84	67,257		
Total	462734,375	90			
Corrected Total	11171,875	89			

a. R Squared = ,494 (Adjusted R Squared = ,464)

Table 3 displays that (1) the GeoGebra-assisted Learning Cycle 7e Model influenced students' mathematical concepts understanding ability; (2) there was an effect of field-dependent and field-independent cognitive styles on students' mathematical concepts understanding ability; and

(3) there was an interaction between the GeoGebra-assisted Learning Cycle 7e Model and cognitive style (FD and FI) on students' mathematical concepts understanding ability. The marginal mean of each group is displayed in Table 4.

Table 4. Marginal Mean of Each Group

Learning model	Marginal Mean
Learning Cycle 7e Model (A1)	73.82
Learning Cycle 7e Model + GeoGebra (A2)	78.79
Conventional model (A3)	56.79

Subsequently, a multiple comparison test (post-ANOVA follow-up) was conducted using Scheffe' method. The Scheffe' method was used to determine which treatment influenced students' mathematical concept understanding ability. The following are the results of the multiple comparison test using SPSS version 2.4 software.

Table 5. The Results of the Double Comparison Test between Rows

(I) Exp1, Exp2, Control	(J) Exp1, Ex2, Control	Mean Difference (IJ)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Experimental Group 1	Experimental Group2	-2.92	2,117	,391	-8.19	2.36
	Control Group	14.79*	2,117	,000	9.51	20.07
Experimental Group 2	Experimental Group 1	2.92	2,117	,391	-2.36	8.19
	Control Group	17.71*	2,117	,000	12.43	22.99
Control Group	Experimental Group 1	-14.79*	2,117	,000	-20.07	-9.51
	Experimental Group 2	-17.71*	2,117	,000	-22.99	-12.43

Based on observed means.
The error term is Mean Square(Error) = 67.257.
*. The mean difference is significant at the .05 level.

Based on the results of the multiple comparison test between rows using the Scheffe' method with a significant level of 0.5, the following conclusions were obtained:

The average difference between Fi (Experimental Group 1) and FJ (Experimental Group 2) was -2.92, which means that E1 - E2 < 0 with a significant value of 0.391. Since 0.391 was higher than 0.05, it can be concluded that there was no influence difference between students who received Learning Cycle 7e Model and those who received the GeoGebra-assisted Learning Cycle 7e Model. Based on the average difference between the two groups, then E1 was lower than E2. Therefore, the GeoGebra-assisted Learning Cycle 7e Model provided better results on students' mathematical concepts understanding than the Learning Cycle 7e Model.

The average difference between Fi (Experimental Group 1) and FJ (Control Group) was 14.79. It means that E1 – K > 0 with a significant value of 0.000. Since 0.000 was lower than 0.05, it can be concluded that there was an influence difference between students who received the Learning Cycle 7e Model and those who received the conventional learning model. Based on the average value difference between the two groups, E1 was higher than K. It means that the Learning

Cycle 7e Model provided better results on students' mathematical concepts understanding than the conventional learning model. These results also complement previous research with the same results (Alfin et al., 2019).

The average difference between Fi (Experimental Group 2) and FJ (Experimental Group 1) was 2.92. It means that E2 – E1 > 0 with a significant value of 0.391. Since 0.391 was higher than 0.05, it can be concluded that there was no influence difference between students who received the GeoGebra -assisted Learning Cycle 7e Model and those who received the Learning Cycle 7e Model. Based on the average difference between the two groups, then E2 was higher than E1. It means that the GeoGebra-assisted Learning Cycle 7e Model provided better results on students' mathematical concepts understanding than the Learning Cycle 7e Model.

The average difference between Fi (Experimental Group 2) and FJ (Control Group) was 17.71. It means that E2 – K > 0 with a significant value of 0.000. Since 0.000 was lower than 0.05, it can be concluded that there was an influence difference between students who received the GeoGebra-assisted Learning Cycle 7e Model and those who received the conventional learning model. Based on the average value difference between the two groups, E2 was higher than K. It means that the GeoGebra-assisted Learning Cycle 7e Model provided better results on students' mathematical concepts understanding than the conventional learning model.

The average difference between Fi (Control Group) and FJ (Experimental Group 1) was -14.79. It means that K – E1 < 0 with a significant value of 0.000. Since 0.000 was lower than 0.05, it can be concluded that there was an influence difference between students who received conventional learning and those who received the Learning Cycle 7e Model. Based on the average value difference between the two groups, then K was lower than E1. The Learning Cycle 7e Model gave better results on students' mathematical concepts understanding than the conventional learning model.

The average difference between Fi (Control Group) and Fj (Experimental Group 2) was -17.71. It means that K –E2 < 0 with a significant value of 0.000. Since 0.000 was lower than 0.05, it can be concluded that there was an influence difference between students who received the GeoGebra-assisted Learning Cycle 7e Model and those who received the conventional learning mode. Based on the average difference between the two groups, then K was lower than E2. It means that the GeoGebra-assisted Learning Cycle 7e Model gave better results on students' mathematical concepts understanding than the conventional learning model.

CONCLUSION

The results of the analysis concluded that: 1) GeoGebra-assisted Learning Cycle 7e Model had a positive influence on students' mathematical concepts understanding ability; 2) cognitive styles (field dependent and field independent) did not influence students' mathematical understanding ability; and 3) there was no interaction between the learning model group (Learning Cycle 7e Model, GeoGebra-assisted Learning Cycle 7e Model, and conventional learning model) and groups' cognitive styles on students' mathematical concepts understanding.

This research provides varied combinations of learning models and media to be applied in the classroom. Further researchers are expected to use the Learning Cycle 7e Model and GeoGebra in conducting further research by replacing variables, methods, and approaches (qualitative, Research and Development, and quantitative approaches.

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