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Considering Students' Prior Knowledge in Culture-based Contextual Learning Media Application: How Effective It is to Support Students' Mathematics Learning Outcome

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Abstract

The present study aims to describe the effectiveness of culture-based contextual mathematics learning media by considering students' prior knowledge. This is a quasi-experimental study that employed pretest-postest non-equivalent group design. Eight graders of a Junior High School (JHS) in Yogyakarta were involved as experimental and control groups. The data were obtained through a test to find out the students' mathematics learning achievements, while the data analysis technique used is the analysis of two-way variance with unequal cells. The results indicate that by considering the students' previous knowledge, the culture-based contextual mathematics learning media is more effective than the conventional ones.

Keywords: contextual, culture, effectiveness, mathematics, media

INTRODUCTION

The goal of National Education is to instill Indonesian character in students, in order that they can have the knowledge to develop science and technology as well as culture (UU No. 12 Tahun 1954 pasal 4). UU No. 20 the year 2003 on National Education System states that the national education serves to develop the ability and character development and civilization of the nation's dignity in the context of the intellectual life of the nation. This means that education is not only a process of transferring knowledge from the teacher to the students but also a means of internalizing the Indonesian character and cultural values (Suastra, 2011).

To achieve the noble goals above, the implementation of education is based on a curriculum that involves planning, implementation, and evaluation. It is more detailed in Permendiknas 41 the year 2007 on the Standard Process, which regulates the learning process and requires educators to develop lesson plans. In the learning process, the teaching materials can be developed through a variety of ways, one of which is by optimizing media. Media used to facilitate communication in the learning process is often termed instructional media (Haryoko, 2009). Thus, learning media should be one of the tools to achieve the goals of national education (Tandililing, 2013).

The current mathematics instructional media has not fulfilled the national education goals. The media are focused on students' cognitive abilities and mastery of technological sophistication. Thus, meaningful learning has not been achieved (Rusydi, 2014). In addition, students do not have sufficient awareness of their own culture and nation.

Education and culture are inevitable in everyday life because the culture is a complete and comprehensive unity prevailing in society, and education is a fundamental requirement for

any individual in society (Wijayanto, 2017). Education and culture have a very important role in growing and develop the noble values of our nation, which affects the development of characters based on the value of the noble culture. Culture-based learning is learning that allows teachers and students to participate actively by involving the culture they are familiar with, to obtain optimal learning outcomes (Pannen, 2005).

One of the factors that influences learning outcome is the students' prior knowledge (Astuti, 2015). In addition, Herawati (2013) also said that such knowledge can contribute to learning outcomes. Nashar (2014) in his book also mentioned the important role of prior knowledge in determining the learning outcomes.

Based on the above description, the purpose of this study is to describe the effectiveness of culture-based contextual mathematics learning media, by taking students' prior knowledge into consideration.

METHOD

This study was quasi-experimental research, involving eighth graders of a JHS in Yogyakarta academic year 2017/2018. A random sampling method was used to decide the control and experimental groups. The data were collected through tests, to determine students' mathematics achievement.

Instrument trials were conducted in a class consisting of 23 students. The learning achievement test instruments referred to some criteria namely content validity, differentiation ($D \geq 0{,}3$), difficulty level ($0{,}3 \leq P \leq 0{,}7$) and reliability ($r11 \geq 0{,}7$), of the 40 tested items, 25 of them were used as a data retrieval tool for students' mathematics learning achievements. The prerequisite test for analysis is the normality test using Lilliefors and the homogeneity test employing Bartlett test. The test of the data analysis used is a two-way analysis of variance with different cells.

RESEARCH RESULT

Before the experiment phase, the sample must be balanced. The data used as a test of balance is the data of the Final Examination or *Ujian Akhir Semester* (UAS) of mathematics in semester 1. The next step was the normality test, homogeneity test and balance test on the data. Based on the normality test employing Lilliefors method, the value of statistics test for the significance level of 0.05 in the experimental class obtained L_{obs} = 0,126 and $L_{0,05;30}$ = 0,161 dan L_{obs} control class= 0,115 and $L_{0,05;27}$ = 0,180, in each sample the value of $L_{obs} < L_{0,05;n}$ with $DK = \{L \ | L > L_{\alpha;n}\}$, with $L_{obs} \notin DK$ so that H_0 is accepted meaning that each sample comes from the population normal distribution.

The results of homogeneity test analysis using *Bartlett* test with Chi-Square statistics test at a significance level of 0.05 obtained that χ^2_{obs} = 2,784 with $\chi^2_{0,05;1}$ = 3,247 mean the value of $\chi^2_{obs} < \chi^2_{0,05;1}$ with $DK = \{\chi^2 \ | \chi^2 > \chi^2_{0,05;1}\}$, $\chi^2_{obs} \notin DK$ so that H_0 is accepted. This means that the sample comes from a population that has a homogeneous variance.

Based on the balance test using one-way ANOVA with unequal cells as the 0.05 significance level obtained F_{obs} = 2,314 with $F_{0,05;1,57}$ = 4,01. Because of the $F_{obs} < F_{0,05;1,57}$ with $DK = \{F \ | F > F_{0,05;1;57}\}$, so $F_{obs} \notin DK$ that H_0 is accepted, meaning that the population is balanced.

Prior to the two-way analysis of variance, tests of normality and homogeneity as a prerequisite test analysis of variance were done. The summary of normality and homogeneity tests is presented in Table 1 and Table 2.

Table 1. Summary of Test Results for Normality

Normality test	L_{obs}	$L_{0,05;n}$	Decision	Result
Culture-based media	0,126	0,161	H_0 accepted	Normal
N	0,115	0,180	H_0 accepted	Normal
High Prior Knowledge	0,094	0,161	H_0 accepted	Normal
Medium Prior Knowledge	0,103	0,161	H_0 accepted	Normal
Low Prior Knowledge	0,126	0,161	H_0 accepted	Normal

Table 2. Summary of the Homogeneity Test

Sample	K	χ^2_{obs}	$\chi^2_{0,05;(k-1)}$	Decision	Result
Instructional Media	2	2,657	3,841	H_0 accepted	Homogenous
Prior Knowledge	3	1,701	5,991	H_0 accepted	Homogenous

Based on Table 1 and Table 2, it can be seen that the sample comes from a population that is normally distributed and has a homogeneous variance, so hypothesis testing using two-way variance analysis techniques with unequal cells can be done.

The average mathematics learning achievement of the experimental group and the control group can be seen in Table 3.

Table 3. Average of Each Cell from Learning Media Data and Prior Knowledge

Instructional Media	Students' Prior Knowledge			Marginal Mean
	High	Medium	Low	
Culture-based media	89,44	74,00	61,64	75,54
Non	83,73	72,16	56,94	69,70
Marginal mean	88,74	73,11	58,27	

The results of the calculation of the two-way variance analysis with unequal cells and the 0.05 significance level are presented in Table 4.

Table 4. Summary of Two-way Analysis of Variance

Source	JK	dk	RK	F_{obs}	F_{α}	Result
Instructional Media (A)	427,84	1	235,14	8,02	3,89	H_0 rejected
Prior Knowledge (B)	4365,42	2	2182,46	40,31	3,05	H_0 rejected
Interaction (AB)	1031,76	2	567,38	9,09	3,05	H_0 rejected
Error (within)	10176,45	52	53,71	-	-	-
Total	16001,47	57	-	-	-	-

The conclusions of the two-way variance analysis with unequal cells are: (1) on the main effects between rows (A), students who are given the culture-based contextual mathematics learning media and those who are not given such media have different learning achievements. (2) in the main effect between columns (B), the students' previous knowledge gave different effects on learning achievement. (3) on the interaction effect (AB), there is an interaction between the learning media used and the students' previous knowledge towards mathematics achievement.

Based on the two-way ANOVA, H_0 A was rejected. Thus, a further test after analysis of variance was needed, employing the Scheffe method for the comparison test between rows.

Table 5. Summary of the Results of Multiple Comparison Test Between Rows

Comparison	H_0	H_1	F_{obs}	$2F_{0,05;2;57}$	Result
$\mu_{1.}$ vs $\mu_{2.}$	$\mu_{1.} = \mu_{3.}$	$\mu_{1.} \neq \mu_{3.}$	14,38	8,02	H_0 rejected

Table 5 shows the results of the comparative test between lines in each learning media category and by looking at the marginal mean, the conclusion is that culture-based contextual mathematics learning media promote higher mathematics learning achievement than any other conventional media. This conclusion is supported by the study of Amir & Kusuma (2018) which shows that contextual learning is able to improve students' achievement. Contextual mathematics learning can also improve students' mathematical problem-solving (Suhartini & Syahputra, 2016).

Based on two-way ANOVA, H_0 B was rejected and further test after analysis of variance was needed using Scheffe method for the comparison test between columns.

Table 6. Summary of the Results of the Multiple Comparison Tests Between Column

Comparison	H_0	H_1	F_{obs}	$2F_{0,05;2;57}$	Result
$\mu_{.1}$ vs $\mu_{.2}$	$\mu_{.1} = \mu_{.2}$	$\mu_{.1} \neq \mu_{.2}$	18,14	8,02	H_0 rejected
$\mu_{.2}$ vs $\mu_{.3}$	$\mu_{.2} = \mu_{.3}$	$\mu_{.2} \neq \mu_{.3}$	11,79	8,02	H_0 rejected
$\mu_{.1}$ vs $\mu_{.3}$	$\mu_{.1} = \mu_{.3}$	$\mu_{.1} \neq \mu_{.3}$	23,86	8,02	H_0 rejected

As presented in Table 6, the results of comparison tests between columns in each of the prior knowledge categories and according to the marginal averages, it is concluded that students with high previous mathematical knowledge have better learning achievement than students with moderate and low prior knowledge. This result is in accordance with the research hypothesis. This is because students who have high mathematics prior knowledge are relatively more confident, determined, curious, can explore mathematical ideas and try various methods to solve problems. This opinion was also strengthened by Hevriansyah & Megawanti (2016) who revealed that previous knowledge is one of the factors that gives a large influence to learning outcomes. The same idea comes from Purwaningrum (2016) who in her study concluded that students with high early grades had high learning outcomes. This result is also in accordance with the research conducted by Anggraini et al. (2013) which found out that there were significant learning outcomes between groups of students with high and low prior knowledge. All of these mentioned relevant studies contend that mathematical prior knowledge has a significant influence on learning outcomes.

Based on the two-way analysis of variance, it was found that H_0 AB was rejected, so that further testing was needed after the analysis of variance with the Scheffe method for the comparison test between cells in each category of learning media and prior knowledge. The results of multiple comparison tests between cells in the same row are described as follows: 1) In classes that use culture-based contextual learning media, students with high prior knowledge achieve better learning outcomes than those with moderate to low prior knowledge. This is because cultural-based contextual learning media are constructivism learning media that demand students' active role in learning activities. Therefore, the media is appropriate for students with high prior knowledge. 3) In the class that did not employ culture-based contextual learning media, students who have high prior knowledge have better learning achievement than students who don't, while students who have a moderate and low prior knowledge achieved the same learning outcomes.

The results of multiple comparison tests between cells in the same column are described as follows: 1) In students with high prior knowledge, those who were given culture-based contextual learning media were as good as those who were taught through to direct learning. 2) In students with moderate prior knowledge, those who dealt with culture-based contextual learning media got similar learning results to those who did not get such media. 3) In students with low previous knowledge, the learning achievements were at the same level, whether the students were given the media or not. This result is not in accordance with the research hypothesis. This can be indicated that students with low prior knowledge tend to be less engaged during the learning process. Thus, at this level of prior knowledge, it is quite difficult to guarantee the occurrence of interactions between students who are given culture-based contextual learning media and those who are not.

CONCLUSION

Based on the results of the study, some conclusions can be drawn: 1) students who studied using culture-based contextual mathematics learning media performed higher learning outcomes than those who did not, 2) students with high prior knowledge showed better learning results than those with low prior knowledge. The same thing is applied to students with moderate prior knowledge who performed better than those with low prior knowledge, 3) in the application of culture-based contextual mathematics learning media, the highest learning outcomes were obtained by the students who have high prior knowledge. In the learning that did not apply the media, the same result is revealed. The students who possess high prior knowledge performed better than those who have moderate and low prior knowledge. Students with average prior knowledge obtained the same learning achievement as students who have low prior knowledge, 4) students with moderate prior knowledge and students with low prior knowledge showed the same learning achievement, regardless of the media implementation.

Based on the conclusions, several suggestions were given. The school principals should always provide motivation, monitoring, and evaluation to the teachers especially mathematics teachers. Those teachers should be motivated to use innovative learning media such as culture-based contextual learning media. The teachers should also pay attention to the students' preceding knowledge since as revealed in this study, such knowledge influences the learning achievement.

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