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The Effect Of Comic-Based Realistic Mathematics Approach On Improving Skill Of Students' Concept Understanding

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Abstract

Learning that involved the daily life accompanied by interesting learning media can be used as an option to help students in learning, particularly in improving students' concepts understanding. It is possible to do by utilization of familiar media that are generally liked by students. One of them is comic. Therefore a research about learning by comic based realistic mathematical approach was carried out in order to find out its effect on improving the skills of students concepts understanding on fraction material. This study is a quasi-experimental research. The population of study are 7th grade students of SMP RK Serdang Murni Lubuk Pakam on Academic Year 2019/2020. The first class that consist of 31 students are categorized as the control class and the second class consist of 32 students are experimental class. The pre-test and post-test questions were provided as an instrument of study. The data were analyzed using the Anova and Welch Brown-Forsythe tests to proof the hypotesis. Moreover, normality test with Liliefors test and the homogeneity test with the Levene's test. The results of this study stated that learning with comics-based realistics mathematical approach has a significant effect on improving the skills of students concept understanding.

Introduction

Mathematics is one of the most needed fields of science. It has a prominent role in science and technology (Acharya, B. R., 2017: 8). Shortly, mathematics may improve one's thinking skills. In the field of education, mathematics is used as a benchmark in determining education achievement, especially in the school environment. This is true, but in reality, mathematics is one of disliked and and bored subject for students. Most of students argued that mathematics is a difficult subject to understand. Mathematics is considered a collection of symbols, formulas, and even saturating problems for students. Most of students dislike mathematics. Thus, in mathematics learning, it is observed that the students cognitive skills are low, including the skill to understand the material and in solving problems solving. This is also related to National Examination scores on mathematics for SMP/MTs in 2019 as provided in the following table:

Table 1. Average of National Examination Scores on Mathematics in 2019

National examination scores on level of:		
District: Deli Serdang	Province: North Sumatra	National
42.40	43.60	45.52

The above table shows that the studenst achievement on mathematics of Deli Serdang distric is lower compared to Province and National score. Thus, it is a challenge for mathematics teachers at the national, provincial, and district/city level in learning activities in the classroom. On the other hand, the mathematics learning problem also arises from the teacher itself. Resnick observes that mathematics is considered as a subject with unambiguous purpose, for teacher places it as a rigid subject and uneeded arguments. It less appreciated by students that leads to be disliking subject (Eshun, ES & Amihere, A. K., 2014: 10).

In the terms of thinking skill, the inability of students in solving mathematical problem is due to the low understanding of mathematical concepts. Angle put forward that most of students are dominant in acquiring process skills rather than the mathematical concepts understanding. In fact, mathematics teaching frequently focuses on rules, procedures, and formulas until the correct answer was found by the students rather than teaching the basic concepts. This fact adrifts the teacher from the important component in teaching mathematics, that is teaching the mathematical concepts for students (Roselizawati, H., Sarwadi, H., & Shahrill, M., 2014: 2). The skills to grasp the mathematical concepts is a key to analyze or solving problems of mathematical algorithms that should be possessed by students. It involves a thorough understanding of the basis algorithms in

mathematics (Andamon, J. C. & Tan, D. A., 2018: 96). Today, the science and mathematics teachers increasingly recognize that conceptual understanding is as important as analyzing self-concepts (Misu, L., Budayasa, I. K., Lukito, A., Hasnawati & Rahim, U., 2019:482). Kilpatrick argues that understanding concepts enable students to organize their knowledge in a coherent manner that allows students to learn new ideas by connecting those ideas with things that students already knew (Mwakapenda, W., 2004). For Orhun, N. (2013: 138), many concepts of mathematics do not mean much to students, but it will be meaningful if the concepts are connected with other mathematics.

In dealing with this problem, it is admitted that learning mathematics related to understand concepts requires a media. A learning media is a tool that attracts the students to participate in the learning process. Concerning the mathematics learning media, Batubara found that any media can be useful for students who are afraid of concrete operational phases in understanding the abstract material and students with less skill in verbal explanation (Bernard, M. & Senjayawati, E., 2019: 46). Thus, one of the effective way is using comics. Comics is one of the known and recognized entertainment media (Upson, M. & C. Hall M., 2013: 29). Digital and print media based comics are familiar to the young generation (Affeldt, F., Meinhart, D. & Eilks, I., 2017: 94). Based on comic characteristics, it contains pictures that are designed in a such way and are interesting, and presented information in text balloons that provided for related images. According to Santana & Arroio, comics have been considered as an important pedagogical source in education and teaching programs (Weber, K.C., et. al., 2013: 2). On the other hand, comic books use complex interactions between images and text that potentially convey the concepts and motivate the student involvement in learning. (Hosler, J. & Boomer, K. B., 2011: 309). Sutino (2003) found that using comics as a learning media may encourage mental and logic development diagrams. It also helps the students to memorize formulas, has the better understanding on problem situations and relationships between data on specific problems (Buchori, S. & Setyawati, R. D., 2015: 371).

In addition to learning media, a learning approach also needed to solve the learning problems. Ball, Thames & Phelps considers that other than the mathematical knowledge, teachers should aware the extent of students understanding and ideas by applying various approaches in teaching (Gloria Sánchez-Matamoros, G. S., Fernández, C., & Llinares, S., 2014:1). Indeed, the teacher should take account on presentation methods to create a learning atmosphere that allows the students to easily understand and be enthusiastic in learning. The inability of students to understand the concepts and solve problems is continuously application of conventional learning method in classes (Jazuli, A., Setyosari, P., Sulthon, & Kuswandi, D., 2017: 49). Therefore, a new approach in learning mathematics concepts that related to young habit could be utilize as an option (Pardimina & Widodo, S. A., 2017: 234).

The easiness of learning can be experienced by students if only the learning content and context are related to daily life (Laurens, T., Batlolona, F. A., Batlolona, J. R., & Leasa, M., 2017: 570). A learning approach that relates mathematics to daily life is known as realistic mathematics approach. Utilization of this approach enable students to understand the mathematical concepts that are relate to daily life problems, as well as discuss the possible solutions to rational solutions that are structured in students thinking concepts (Ozkaya, A. & Karaca, S. Y., 2017: 186). Searle, J., & Barmby, P. states that realistic mathematics education is part of contextual learning where children participate in learning through activities that solve real problems in meaningful contexts (Hidayat, R. & Iksan Z. H., 2015: 2440). A realistic mathematical approach may helps students to manage memory better (Web, C. D, Kooji, H. V. D. & Geist, M. R., 2011: 48). The underlies philosophy on realistic mathematics learning is, students may develop their mathematical understanding by working from contexts that make sense for themselves (Dickinson, P. & Hough S., 2012:1).

The learning step in realistic mathematical approach includes the stages of contextual problems and solving contextual problems understanding, comparing and discussing the answers, and concluding (Afthina, H., Mardiyana, & Pramudya, I., 2017: 2). The previous research that supports the effect of realistic mathematical approach in learning is Saleh Prahman, Isa and Murni (2018). These studies revealed that that student achievement in learning mathematics with a realistic mathematical approach is better than conventional learning.

Based on these arguments, this study attempt to identify the impact of comic-based realistic mathematical approaches on improve the students concept understanding. The results of this study is expected to provide an insight for teachers or education practitioners related to mathematics learning.

Method

This study is a quasi-experimental with pre-test and post-test control group design which is presented in the following table:

Table 2. Pretest and Posttest Control Groups Design

Groups	Pre-test	Treatment	Post-test
Experiment	O_1	X	O_2
Control	O_3	-	O_4

The variables in this study include independent variables and dependent variables. The independent variables are learning approaches that consist of comic-based realistic mathematical approaches and expository approaches. The dependent variable is the skill of students to understand the concepts of fraction numbers. The population of study are 7th grade students of SMP RK Serdang Murni Lubuk Pakam on Academic Year 2019/2020. The sample selection was carried out by simple random sampling. Based on this sampling technique, the first class that consist of 31 students are categorized as the control class and the second consist of 32 students are experimental class. In treatments, the experimental class was taught with a comic-based realistic mathematical approach, while the control class was taught with an expository approach. The procedure of this research is described as follows:

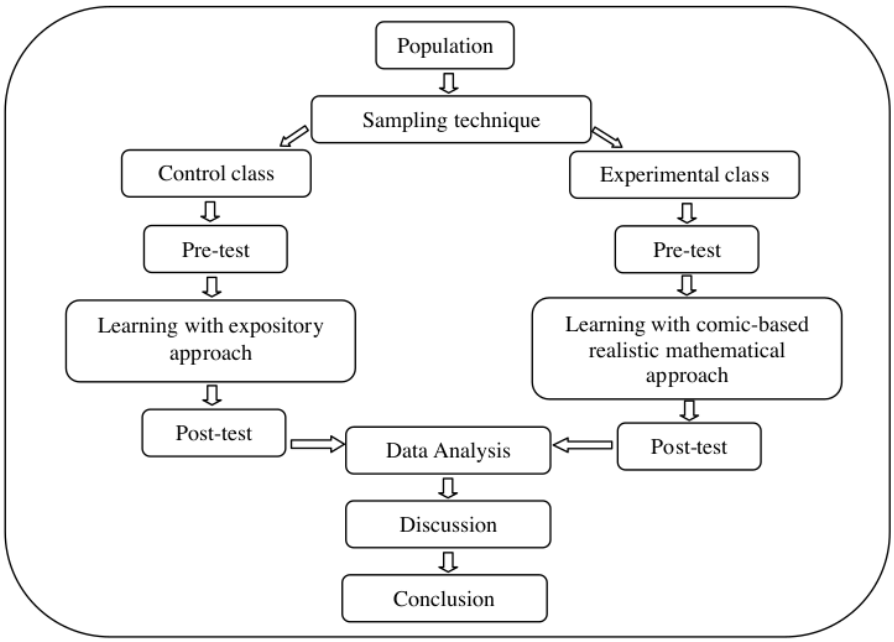

Figure 1. Research Procedure

The comics used as learning with a realistic mathematical approach are partially presented in the following figure:

Figure 2. Sections of Comic Contents

Data was derived from the results of test on mathematical concept comprehension skill that consist of initial test (pre-test) and a final test (post-test). Each test contains five indicators of the skill to understand mathematical concepts: (1) restate a concept; (2) classifying objects according to certain characteristics according to the concept; (3) giving examples and non examples of concepts; (4) states the concept in the form of mathematical representation; and (5) applying concepts or algorithms in problem solving. The test instrument was validated. The treatment was conducted on 32 students of 7th grade who were considered have studied material related to the pre-test and post-test given. In addition, in testing the validity and reliability of the instruments, the difficulty level of pretest and posttest items were analyzed. The results of tests is presented in table 3:

Table 3. Recapitulation of Test Trial Results

Type of Test		Items	Validity		Reliability		Distinguishing Power		Difficulty Level	
Concept understanding skill	Pre-test	1	0,80	valid	0,81	reliable	0,67	Good	0,67	moderate
		2	0,68	valid			0,58	Good	0,46	moderate
		3	0,68	valid			0,64	Good	0,40	moderate
		4a	0,82	valid			0,86	very good	0,57	moderate
		4b	0,85	valid			0,89	very good	0,53	moderate
	Post-test	1a	0,68	valid	0,85	reliable	0,47	good	0,40	moderate
		1b	0,77	vaild			0,78	very good	0,61	moderate
		2	0,79	valid			0,47	good	0,43	moderate
		3a	0,77	valid			0,67	good	0,64	moderate
		3b	0,74	valid			0,61	good	0,58	moderate
		4	0,56	valid			0,22	fair	0,33	moderate

Table 3 shows that all pretest and post-test items are valid and reliable. The distinguishing power for the average pre-test items categorized as good and very good, while post-test item 4 is in fair category. However the rest items are in the good and very good category. For the level of difficulty, all items of pre-test and post-test are in the moderate category. Based on this results, it is concluded that the pretest and posttest questions can be used as a tool to measure students concept understanding skill.

As initial data processing, the skill to understand the mathematical concepts in the form of average data presentation and standard deviation of normalized gain are described. The formula of n-gain calculation based on Hank (2002):

$$N\ Gain = \frac{Posttest\ \ scores - \Pr etest\ scores}{Ideal\ \ scores - \Pr etest\ \ scores} \qquad (1)$$

The prerequisite test that consist of normality and homogenity is also conducted. In addition, the Welch Brown-Forsythe test was used as a correction test for the Anova test to ensure that there were no differences in variance

of students concept understanding skills in both groups. Homogeneity test was done with Levenes test. The hypothesis for homogeneity testing is as follows:

H_0 : There is no difference in increasing students conceptual understanding skill between the experimental and the control group

H_1 : There is a difference in increasing students conceptual understanding skill between the experimental and the control group

The data normality test uses Liliefors. The hypothesis for testing the normality is as follows:

H_0 : The residual data of increasing skill on concept understanding has normal distribution

H_1 : The residual data of increasing skill on concept understanding has non-normal distribution

Moreover, hypothesis test was conducted using the Anova with significance level $\alpha = 0{,}05$ in determining the influence of comic-based realistic mathematical approaches in improving the students concepts understanding skills. The hypotheses formulated are as follows:

H_0 : There is no effect of learning with comic-based realistic mathematical approaches on increasing the skill of students concepts understanding

H_1 : There is an affect of learning with comic-based realistic mathematical approaches to improving the skills of students' concepts understanding

Results and Discussion

Results

The results of descriptive tests on student's increasing skill to understand the concepts of material fractions are presented in the following table:

Table 4. Descriptive Statistics

Treatment	Mean	Std. Deviation	N
Control	-.0842	.63683	31
Experimental	.3870	.40645	32
Total	.1551	.57899	63

Tabel 3 shows an increasing of students skills to understand the mathematical concepts in the control class. This is figured out by the average value is negative (-0.0842) with a standard deviation of 0.63683. On the other hand, an increasing in students skill is also showed in experimental class, where the mean was 0.3870 compared to standard deviation of 0.40645.

Before conducting the hypothesis-test, a variance homogeneity test was carried out using the Levene test to identify whether there was a similarity in variance of students skill in understanding of concepts among the control group and the experimental group. The homogeneity test is a requirement for Anova test. In terms of unhomogeneous, the Anova test results will be corrected using the Welch Brown-Forsythe test. The results provides in table 5:

Table 5. Levene's Test of Equality of Error Variances[a]

F	df1	df2	Sig.
7.027	1	61	.010

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Treatment

Based on the Levene test, the p value is sig 0.010 < 0.05. It was concluded that H_1 is accepted that means there is a significant difference in variance between both groups (non-homogeneous). This means that the assumption of variance homogeneity is unfulfilled. Therefore the Anova test will be justified with Welch Brown-Forsythe test.

The result of Anova test before justified with Welch Brown-Forsythe test showed that pvalue = 0.001 < 0.05. It is concluded that H_1 is accepted, that means that the influence of treatment on students skill is significant, which indicates that the increase of students skill on concept understanding in the experimental group is better than control group. The effect of treatment on increasing the skill is equal to R Square = 0.155 or 15.5% presented in table 6:

Table 6. Tests of Between-Subjects Effects

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3.497[a]	1	3.497	12.337	.001	.168
Intercept	1.444	1	1.444	5.095	.028	.077
Treatment	3.497	1	3.497	12.337	.001	.168
Error	17.288	61	.283			
Total	22.301	63				
Corrected Total	20.784	62				

a. R Squared = .168 (Adjusted R Squared = .155)

The estimated coefficient is used in forming the Anova equation to determine the value of students increasing skill. The treatment in the control group has a significant difference compared to the experimental group. This is revealed on the estimated coefficient value of -0.471 with a p value of 0.001< 0.05. Since the estimated coefficient value on control group is negative, this is indicate that the estimated value on increasing skill for experimental group is better than the control group. It is also significant, for p value 0.001 < 0.05, or H_1 is accepted.

Thus, equations to determine the increasing skill value are as follows: (1) $Y_1 = 0.387\ 0.471 + e$, where Y_1 is the estimated value of increasing skill for the control group, and e is an error or other factors outside the model. (2) $Y_2 = 0.387 + 0 + e$, where Y_2 is estimated value increasing the skill for experimental group, and e is an error or other factors outside the model. The values of Y_1 and Y_2 are estimated values or signify as predictive Y. Whereas, the real Y is the actual Y. The residual or estimated error is the actual predictive Y. Data of the estimated parameters can be seen in the following table:

Table 7. Parameter Estimates

Parameter	B	Std. Error	T	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound	Partial Eta Squared
Intercept	.387	.094	4.113	.000	.199	.575	.217
[Treatment =1]	-.471	.134	-3.512	.001	-.739	-.203	.168
[Treatment =2]	0[a]	.	.	.	.	.	.

a. This parameter is set to zero because it is redundant.

The average estimated value on increasing of concept understanding skill in all groups, both the control and experimental groups was 0.151. It is can be seen in the following table:

Table 8. Grand Mean

Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
.151	.067	.017	.286

The estimated value of experimental group is 0.387 > the control group is -0.084. The average estimated value of increasing skill for control and experimental groups are presented in following table:

Table 9. Treatment

Treatment	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Control	-.084	.096	-.275	.107
Experimental	.387	.094	.199	.575

The estimated average value of increasing skill to understand concepts between both groups is figure out as follow:

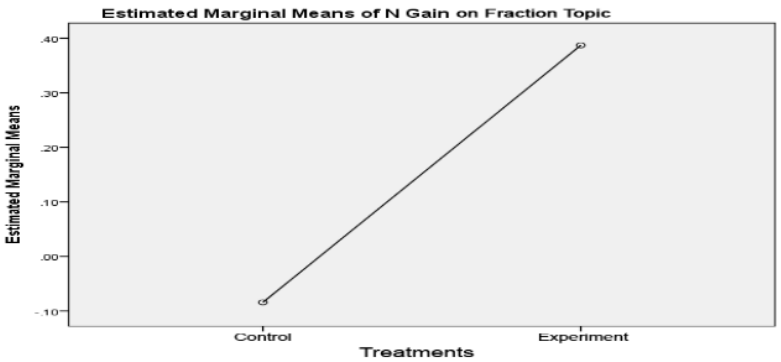

Figure 3. Average Estimated Values

Figure 3 shows that the line skewness to the right top is greater than the line skewness on the bottom left. It can be concluded that the estimated value on increasing of concept understanding in experimental group is greater than the control group. For normality, the Liliefors test is used. Normality test is carried out on standardized residuals. The result showed p value = 0.071 > 0.05, H_1 is rejected, which means that the residuals are normally distributed.

Table 10. One-Sample Kolmogorov-Smirnov Test

		Standardized Residual for N Gain of Concept Understanding Skill
N		63
Normal Parameters[a,b]	Mean	.0000
	Std. Deviation	.99190
Most Extreme Differences	Absolute	.107
	Positive	.068
	Negative	-.107
Test Statistic		.107
Asymp. Sig. (2-tailed)		.071[c]

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.

The increasing of concepts understanding skill is presented in the following Anova test:

Table 11. ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	3.497	1	3.497	12.337	.001
Within Groups	17.288	61	.283		
Total	20.784	62			

The results showed that $F_{count} \geq F_{table}$ = 12.333, and the probability value is 0.001< 0.05. it means that H_1 is accepted. It also indicates the differences in the average increase of concept understanding skill between experimental and control group. The correction to homogeneity used Welsh Brown-Forsythe is presented in table.

Table 12. Robust Tests of Equality of Means

	Statistic[a]	df1	df2	Sig.
Welch	12.171	1	50.707	.001
Brown-Forsythe	12.171	1	50.707	.001

a. Asymptotically F distributed.

Since the p value obtained is 0.001 < 0.05, the H_1 was accepted, which means the effect of treatment on increasing of concept understanding skill is significantly. The increasing skill on concepts understanding in the experimental group is better than the control group. This results can be generalized to different places, subjects and times. Finally, it was concluded that there was an influence of comic-based realistic mathematical approaches in learning on improving skill of students concepts understanding.

Discussion

This study confirms that there is an influence of learning with comic-based realistic mathematical approaches on improve skill of students mathematical concepts understanding. This is known from the difference on the increasing average of students skill in group who are taught with comic-based realistic mathematical approach compared to group who are taught with expository approach. The average value of increasing students on mathematics concepts understanding in the experimental class is higher than control class.

In addition, the the mathematic learning with comic-based realistic mathematical approaches aided the students to understand mathematical concepts easily and actively in learning. It is reflected from the students attitude who are competing to comment on mathematical concepts they obtained after reading comics in the classroom. This was absent in group of students who are taught with expository approach, where the teacher involvement is found dominant. This finding is in line with study conducted by Hosler, J. and Boomer, K. B. (2011) which proposed that the comics used in learning has potential effect to convey concepts and motivate student involvement on mathematics. The interaction between complex images and text presented in comics can attract students' attention.

Furthermore, comic can be used as realistic mathematics learning to improve the students skill to understand the mathematical concepts. Lestari, L. & Surya E. (2017) propose that realistic mathematical approaches are effective in improving students' mathematical concepts understanding. Finally, this study confirms that learning with comic-based realistic mathematical approach improve the students conceptual understanding skills.

Conclusion

Based on the results and discussion above, it can be concluded that there is an effect of learning with comic-based realistic mathematical approache to improve the students concepts understanding skills. This is revealed from the difference on the increasing average of students skill in group who are taught with comic-based realistic mathematical approach compared to group who are taught with expository approach. The result of Anova test with corrections based on the Welsh Brown-Forsythe test indicates that the hypothesis that proposes the influence of learning with comic-based realistic mathematical approaches to improve the skill of students understanding on mathematics concept is accepted. The influence is significant and meaningful and can be generalized to different places, subjects, and times.

Therefore, the results of this study propose this approach as one of options for teachers in overcoming mathematics learning problems concerning the effort to improve students understanding of mathematical concepts. Thus, comic-based realistic mathematical approaches can be used as an opt with significant influence in improving the students concepts understanding.

Recommendations

This research is one of the interesting studies and the results of this study are useful in improving on students' mathematical concepts understanding skills. It is therefore recommended for teachers who apply learning by comic based realistic mathematical approaches to design comics as attractive and realistic as possible. Because based on the writer's observation, during the learning process that take place students are more enthusiastic in reading and explaining the contents of comics that are designed with interesting pictures and clear text. In addition, students easily understand mathematical concepts if they are related to problem of daily life. Therefore it is also recommended that the realistic mathematics approach be used more often as a learning approach by the teacher so that students can learn mathematics interestingly and fun and make learning meaningful for students.

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