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Application of TTW (Think-Talk-Write) learning model using pictorial riddle worksheet to improve students's conceptual undertstanding abilities

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Abstract. This study aims to see an increase in students' ability to understand concepts after applying the TTW (Think-Talk-Write) learning model assisted by Pictorial Riddle-based Student Worksheet. The research method used is quasi-experimental. There were two experimental classes, namely the modeling class and the implementation class. The sample of this study was 24 students of class XI Science 4 as modeling class and 23 students of class XI Science 3 as implementation class in Prambanan High School 1 Yogyakarta. Data collection techniques were carried out by Pretest and Post-Test. Data were analysed using the Wilcoxon test and descriptive analysis to determine the N-Gain score. The results showed that the TTW (Think-Talk-Write) learning model assisted by Pictorial Riddle-based Student Worksheet could improve students' conceptual understanding abilities. This is indicated by the value of Asymp Sig. (2-tailed) smaller than 0.05 where 0.046 < 0.05 and the N-Gain score is 0.2061 in modeling class and Asymp Sig. (2-tailed) smaller than 0.05 where 0.003 < 0.05 and the N-Gain score is 0.2775 in implementation class. The conclusion is this model has an effect on the students' ability to understand concepts with a low increase category.
Keywords: *TTW (Think-Talk-Write), pictorial riddle, conceptual understanding*

1. Introduction

The ability to understand concepts that are weak against physical principles is one of the factors causing the lack of students' physics problem solving abilities [1]. Students tend to solve problems using a procedural approach and directly translate story problems into algorithms and formulas that can be solved [2], [3]. Whereas the solution of conceptual problems requires conceptual understanding rather than algorithms [3]. For this reason, it is necessary to apply an appropriate physics learning model to improve students' conceptual understanding skills.

One learning model that can be used is the cooperative learning model. The application of this model can improve students' conceptual understanding abilities [4]. In cooperative learning, concepts and materials are considered during class by means of discussion, debate and clarification. The proof of understanding the material is that students can explain their ideas to their peers. A sense of independence and not depend on others to understand the concept can be encouraged by using this model. [5]. In the sense that students in this learning have space to think (Think), discuss (Talk), and conclude the concept (Write) so summarized with TTW.

TTW, as the name implies, has stages of learning through thinking, speaking and writing [6]. The strategy introduced by Huinker and Laughlin is stated as a strategy used by students to think, reflect, organize ideas and test ideas before writing them. Then communication and sharing of ideas between one student with other students. The final process is to write their thought into writing [7].

In helping learning, teachers can use Student Worksheets. Physics in its application can be found in everyday life. The learning model with guided inquiry using Pictorial Riddle will help represent the concepts of physics in everyday life [8]. Pictorial Riddle-based Student Worksheet, one of the method that can increase students' conceptual understanding [9], [10].

In this study, it focuses on practicing the students' conceptual understanding abilities. Studies have shown that conceptual understanding can be improved by cooperative learning models but there is still little in the application of the TTW (Think-Talk-Write) type in physics subjects to improve students' conceptual understanding. With the help of Pictorial Riddle-based Student Worksheet, this study aims to improve the ability of students to understand concepts through TTW (Think-Talk-Write) learning models using Pictorial Riddle Student Worksheet

2. Research Method

To answer the research question, there an increase in students' conceptual understanding ability after the TTW (Think-Talk-Write) learning model assisted by the Pictorial Riddle Student Worksheet, then quantitative research was conducted at Prambanan High School 1 Yogyakarta. In this study, the measured variable is the ability to understand students' concepts. While the research design is a quasi-experiment with one group Pretest -Posttest design as shown in table 1.

Table 1. Research Design.

O_1	X	O_2

Where O_1 = Pretest , O_2 = Posttest , and X = implemented TTW method using pictorial riddle worksheet.

This research involves 24 students of class XI Science 4 and 23 students of class XI Science 3. There were two experimental classes, namely the modeling class and the implementation class. XI Science 4 was modeling class and XI Science 3 was implementation class. These classes were taught by the same method. The modeling class was taught by the researcher and implementation class was taught by a physics subject teacher. The sampling technique was based on random sampling. The data obtained in the form of a score of students' concept understanding ability. The instrument used to collect the data was a test sheet for the ability to understand concepts in the optic. While data collection techniques were done through pretest and posttest . Analysis was performed using the spss 16.0 program. The data were analyzed using the wilcoxon test and descriptive analysis to determine the n-gain score.

The first analysis conducted was to test the result data using the spss program with the wilcoxon test. This test is an alternative to paired sample t test if the data are not normally distributed. From this test we want to know whether there are differences in the average of two samples that are in pairs. Then the test result data is carried out an n-gain test. Increased ability to understand concepts can be seen by using the n-gain (improvement category). As for obtaining the gain based on the average score of the pretest and posttest used the Hake formula, as follows:

$$g = \frac{S_{post} - S_{pre}}{100 - S_{pre}} \quad (1)$$

Information, g (gain) is attainment of attitudes towards science, S_{post} is average percentage of attitudes towards final science (posttest) and S_{pre} is average percentage of attitude score toward early science (pretest).

The category of gain (gain) the ability to understand concepts and think critically as outlined in table 2.

Table 2. Category Gain (increase) cognitive ability test results [8].

Interval	Category
$0,7 \leq G < 1$	High

$0{,}3 \leq G < 0{,}7$	Medium
$0 \leq G < 0{,}3$	Low

3. Result and Discussion

3.1. Result

After the research conducted by providing a conceptual understanding test in the form of an essay to students of grade XI Science in Prambanan High School 1 Yogyakarta with a total of 47 students as the sample, 24 students of modeling class and 23 students of the implementation class. After the complete data collected were analyzed using spss 16.0 program. The descriptive analysis, assumption test, wilcoxon test, and n-gain test was conducted to analysis data. For more information about the results of analyzing test can be seen in description below.

3.1.1. Descriptive analysis. At the beginning of the study, Pretest was given in modeling and implementation class. After the method was done, posttest was given in modeling and implementation class. The information of descriptive analysis from data pretest and posttest can be seen in table 3.

Table 3. Results of descriptive analysis pretest and posttest .

Test	Class	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Pretest	Modeling	24	20	73	1299	51.96	14.571
	Implementation	23	37	73	1313	57.13	13.802
Posttest	Modeling	24	33	100	1553	64.83	22.728
	Implementation	23	40	87	1643	71.52	14.330

From table 3, it is known that the Pretest score of the modeling class is 51.96, while the Pretest score of implementation class is 57.13. This shows that the Pretes tscore of implementation class is higher than the modeling class. From this Pretest score, it indicates that the conceptual understanding of implementation class student is better than modeling class student. The result of posttest shown in table 3, it is known that the posttest score of the modeling class is 64.83, while the posttest of the implementation class is 71.52. From this posttest score, it indicates that the conceptual understanding of implementation class is higher than the modeling class.

The results of the average pretest and posttest score in the TTW modeling class and implementation class are presented in figure 1.

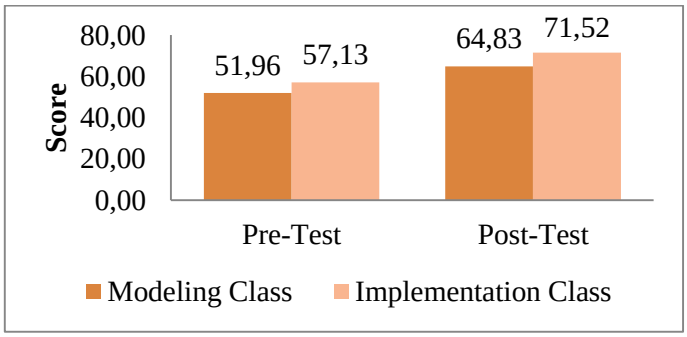

Figure 1. Comparison of average pretest and posttest score.

Figure 1 shows that both the modeling class and the implementation class have increased Pretest to Posttest score. It means based on the increased Pretest and Posttest score, the students' conceptual understanding skill are improving. It can be concluded that the Think Talk Write method using Pictorial Riddle is effective in improving students' conceptual understanding of grade XI at Prambanan High School 1 Yogyakarta with optic as a topic.

3.1.2. The normality and homogeneity test. The normality test and homogeneity test of data were conducted before finding the N-Gain. This basic assumption test was carried to determine if the data distributed normally or not and homogeneous or not. The results of normality can be seen in table 4.

Table 4. Normality Test Output.

		Shapiro-Wilk		
	Class	Statistic	df	Sig.
Pretest	Modeling	0.949	24	0.259
	Implementation	0.880	23	0.010
Posttest	Modeling	0.891	24	0.014
	Implementation	0.879	23	0.010

[a] This is a lower bound of the true significance.

Based on the result of normality test in Table 4, sig. of Pretest score are 0.259 for Modeling class and 0.010 for implementation class. Sig. of Posttest score are 0.014 for Modeling Class and 0.010 for implementation class. From this results the sig. which > 0.05 just Pretest in modeling class and the rest of theme <0.005. It means the data of Pretest in implementation class and the data of Posttest in two classes are note distributed normally. The second test was the homogeneity test. The test result can be seen in table 5.

Table 5. Homogeneity test output.

	Levene Statistic	df1	df2	Sig.
Pretest	0.075	1	45	0.786
Posttest	12.050	1	45	0.001

Table 5 shows Sig. of Pretest 0.786 > 0.05 and Posttest 0.001 < 0.05. It can be concluded that the Pretest data is homogeneous variance and the Posttest data is not homogeneous variance.

3.1.3. The wilcoxon test. The normality test showed three of four data were not normally distributed. So, the statistics analysis that used was the Wilcoxon Test, instead of paired sample t-test. The Wilcoxon test was used to examine the hypothesis. The hypothesis proposed in this study is: H_0: There is no significant difference between the results of the conceptual understanding pretest and posttest. H_1: There is a significant difference between the results of the conceptual understanding pretest and posttest.
With the basic decision making as follows:

- If the Asymp Sig. (2-tailed) is smaller than <0.05, so H_0 is rejected.
- Conversely, if Asymp Sig. (2-tailed) is smaller than <0.05, so H_0 is accepted.

Based on the results of the analysis of students' conceptual understanding scores using the Wilcoxon test, the output results are shown in Table 6 for modeling class and table 7 for implementation class.

Table 6. Wilcoxon test output of modeling class (a) ranks and (b) test statistics.

		N	Mean Rank	Sum of Ranks
Post - Pre	Negative Ranks	9[a]	7.22	65.00
	Positive Ranks	13[b]	14.46	188.00
	Ties	2[c]		
	Total	24		

[a] Post < Pre
[b] Post > Pre
[c] Post = Pre

	Post - Pre
Z	-1.998[a]
Asymp. Sig. (2-tailed)	0.046

[a] Based on negative ranks.
[b] Wilcoxon Signed Ranks Test

The interpretation of output in Table 6 is divided into two parts. First is in table 6 (a) and second in table 6 (b). The negative ranks in Table 6 (a) shows N = 9. It means that there are 9 students who have lower Posttest score than Pretest Score. The average of decreased score is 7.22 while the sum of rank is 65.00. The positive rank shows N = 13. It means that there are 13 students who have higher Posttest score than their Pretest Score. The average of increased score is 14.46 while the sum of rank is 188.00. The ties category shows N = 2. It means that there are 2 students who have same Pretest score as Posttest score. The second interpretation, Table 6 (b) shows that Asymp. Sig. (2-tailed) is 0.046. From these results a decision will be made whether there is an effect of the application of the TTW (Think-Talk-Write) model aided by the Pictorial Riddle Student Worksheet on the ability to understand students' concepts.

From the results of the Wilcoxon Test analysis shown in Table 6 (b) can be decided, Asymp Sig. (2-tailed) is smaller than 0.05 where 0.046 < 0.05 so that the decision H_0 is rejected and H_1 is accepted. This means that there are differences in the results of the students' conceptual understanding Pretest and Posttest at modeling class, so it can also be concluded that "there is an effect of the application of the TTW (Think-Talk-Write) learning model aided by the Pictorial Riddle Student Worksheet in class on the ability to students' conceptual understanding.

Table 7. Wilcoxon test output of implementation class (a) ranks and (b) test statistics.

		N	Mean Rank	Sum of Ranks
Post - Pre	Negative Ranks	4[a]	7.25	29.00
	Positive Ranks	17[b]	11.88	202.00
	Ties	2[c]		
	Total	23		

[a] Post < Pre
[b] Post > Pre
[c] Post = Pre

	Post - Pre
Z	-3.012[a]
Asymp. Sig. (2-tailed)	0.003

[a] Based on negative ranks.

[b] Wilcoxon Signed Ranks Test

The interpretation of output in table 7 is divided into two parts. First is in table 7 (a) and second in table 7 (b). The negative ranks in Table 7 (a) shows N = 4. It means that there are 4 students who have lower Posttest score than Pretest Score. The average of decreased score is 7.25 while the sum of rank is 29.00. The positive rank shows N = 17. It means that there are 17 students who have higher Posttest score than their Pretest Score. The average of increased score is 11.88 while the sum of rank is 202.00. The ties category shows N = 2. It means that there are 2 students who have same Pretest score as Posttest score.

The second interpretation, table 7 (b) shows that Asymp. Sig. (2-tailed) is 0.003. From the results can be decided, Asymp Sig. (2-tailed) is smaller than 0.05 where 0.003 < 0.05 so that the decision H_0 is rejected and H_1 is accepted. This means that there are differences in the results of the students' conceptual understanding Pretest and Posttest at implementation class, so it can also be concluded that "there is an effect of the application of the TTW (Think-Talk-Write) learning model aided by the Pictorial Riddle Student Worksheet in class on the ability to students' conceptual understanding."

Even though these two classes have the same decision but there is a different which can be seen in diagram of figure 2.

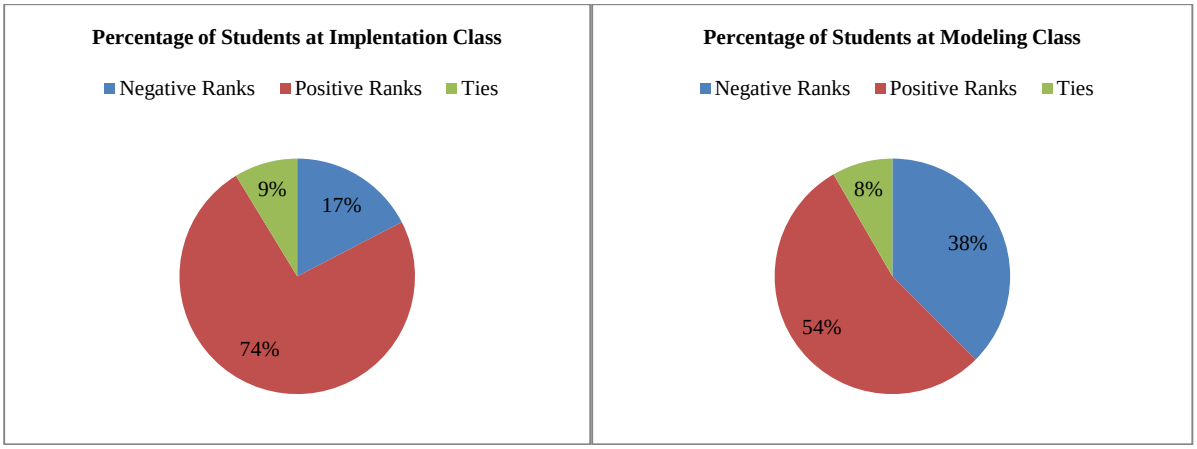

Figure 2. Percentage of student based on category at ranks output.

From figure 2, it can be seen that percentage of students in positive ranks is 54% at modeling class and 74% at implementation class. It can be concluded that total students at implementation class who have increased score Pretest to Posttest is higher than modeling class. The highest effect of the application of the TTW (Think-Talk-Write) learning model aided by the Pictorial Riddle Student Worksheet is in implementation class.

The analysis of the results is time factor, teacher factor and student factor. First, the modeling class was conducted first. While the implementation class was conducted after modeling class and previous evaluations had been carried out. Second, the teacher knew the students better so the teacher was better at doing classroom conditioning. The class was well managed by the teacher. Third, from the Pretest data shown in Table 3, the average score of implementation class is 57.13 which higher than modeling class average score, 51.96. It can be interpret that the initial ability of students' conceptual understanding at implementation class is better than modeling class.

3.1.4. N-Gain test. The final statistics analysis of the data is N-Gain Score Test. Data analysis of the results of the Pretest and Posttest is descriptive analysis to determine the N-gain which can be seen in table 8.

Table 8. Descriptives of n-gain values.

	Class			Statistic	Std. Error
Ngain_score	Modeling	Mean		0.2061	0.11054
		95% confidence interval for mean	Lower bound	-0.0226	
			Upper bound	0.4347	
		5% trimmed mean		0.2160	
		Median		0.1083	
		Variance		0.293	
		Std. Deviation		0.54156	
		Minimum		-0.77	
		Maximum		1.00	
		Range		1.77	
		Interquartile range		0.94	
		Skewness		-0.085	0.472
		Kurtosis		-1.027	0.918
	Implementation	Mean		0.2775	0.09020
		95% confidence interval for mean	Lower bound	0.0905	
			Upper bound	0.4646	
		5% trimmed mean		0.3088	
		Median		0.4255	
		Variance		0.187	
		Std. Deviation		0.43258	
		Minimum		-0.82	
		Maximum		0.79	
		Range		1.61	
		Interquartile range		0.60	
		Skewness		-1.184	0.481
		Kurtosis		0.743	0.935

From table 8, information on N-Gain values is obtained so that the average score of the increase (gain) of the test results of students' concept understanding ability. At modeling class, the average N-Gain score is 0.206, the minimum N-Gain score is -0.77 and the maximum N-Gain score is 1.00. At implementation class, the average N-Gain score is 0.2775, the minimum N-Gain score is -0.82 and the maximum N-Gain score is 0.79. The N-Gain score is then interpreted according to table 2 to find out the category of improvement.

At modeling class, the average N-Gain score produced is 0.206 so if interpreted based on Table 2, the score will be entered at an interval of $0 \leq g < 0.3$ with a low increase category. At implementation class the average N-Gain score produced is 0.2275 so if interpreted based on table 2, the score will be entered at an interval of $0 \leq g < 0.3$ with a low increase category. So that from the discussion of the two results of the Pretest and Posttest score from two classes analysis, it can be concluded that the application of the TTW (Think-Talk-Write) learning model assisted by the Pictorial Riddle Student Worksheet

shows that there is an influence on the students' understanding ability in the concept of a low increase category.

3.2. Discussion

One of research related to TTW (Think-Talk-Write) learning model was conducted by Sagala, Sari, Firdaos and Amalia. Their research results comparing two strategy models namely TTW and RQA showed the results that the learning strategy with TTW had a better influence on students' conceptual understanding of physics than the RQA strategy [12]. Then, the results of research conducted by Ilyas showed that the application of the TTW (Think Talk Write) learning model can improve understanding of the concept of theoretical material and the atomic model of students [13].

The results of research conducted by Chusni showed that the application of learning by the pictorial riddle method was able to improve students' understanding of physics concepts [10]. The other research is research conducted by Awal. From the results of data analysis students who were taught with the Pictorial Riddle method obtained N-Gain = 0.48, which means that students' mastery of physics concepts has increased in the medium category [14].

The TTW, one of cooperative learning model was combined with Pictorial Riddle that has impact to improve students' conceptual understanding. Pictorial Riddle worksheet can provide student at first step of TTW, Think to solve the problem with aided by pictures. Utilizing the translation of image representations, verbal and physics representations to solve physics problems will provide opportunities for students to think like physicists [15]. The second step is Talk. Through the Talk step, the teacher can find out how far the students' knowledge is. In addition, students gain social experience when communicating related to their ideas to a larger group or community in order to achieve a better understanding of concepts [16]. The last step is Write. After students discuss an idea or concept, they must explicitly state its meaning, negotiate the idea to reach consensus and write it down on paper so that it becomes knowledge of the results generated from this process. In learning science process, the synergy between Talk and Write can effectively engage students in high-level cognitive abilities and the development of conceptual knowledge [17]. So the three stages are carried out in stages will form cooperative learning models that can help students in understanding physics concepts.

4. Conclusion

Based on the results and discussion, it was stated that there was a significant difference between the average value of concept comprehension ability in the Pretest and Posttest after the TTW (Think-Talk-Write) learning model assisted by the Pictorial Riddle Student Worksheet both in modeling and implementation classes. A better improvement is shown by the implementation class compared to the modeling class. But the increase in the average value of students' understanding of the concept ability both in two classes is in the category of low improvement. Thus, the application of this model shows there is an influence on the ability to understand students' concepts but with a low improvement category.

References

[1] Jonassen D 2011 *Interdisciplinary Journal of Problem-based Learning* **5** 8 https://doi.org/10.7771/1541-5015.1256
[2] Jonassen D 2003 *Journal of research on Technology in Education* **35** 362-81 https://doi.org/10.1080/15391523.2003.10782391
[3] Bilgin I, Šenocalk E and Sözbilir M 2009 *Eurasia Journal of Mathematics, Science & Technology Education* **5** 153-64 https://doi.org/10.12973/ejmste/75267
[4] Veloo, Ali, and Chairany 2016 *Malaysian Journal of Learning and Instruction* **13** 97-123
[5] Li M P and Lam B H 2013 *Cooperative learning: the Active Classroom* (Hong Kong: The Hong Kong Institute of Education)
[6] Husnal N U and Surya E 2017 *International Journal of Sciences: Basic and Applied Research (IJSBAR)* **34** 1-12

[7] Suminar R P 2015 *Journal of English Language and Learning* **2** 299-304
[8] Damayanti F and Jatmiko B 2018 *Inovasi Pendidikan Fisika* **7** 227-9
[9] Kristianingsih, Sukiswo, and Khanafiyah 2010 *Jurnal Pendidikan Fisika Indonesia* **6** 10-13 https://doi.org/10.15294/jpfi.v6i1.1095
[10] Chusni 2016 *Jurnal Pendidikan Fisika Universitas Muhammadiyah Metro* **4** 111-23 http://dx.doi.org/10.24127/jpf.v4i2.540
[11] Hake R R 1999 *American Journal of Physics* **66** 64–74. https://doi.org/10.1119/1.18809
[12] Sagal R, Sari P M, Firdaos R and Amalia R 2019 *Tadris: Jurnal Keguruan dan Ilmu Tarbiyah* **4** 87-96 https://doi.org/10.24042/tadris.v4i1.4315
[13] Ilyas 2018 *Proc. Seminar Nasional Quantum (Yogyakarta)* vol 6 (Yogyakarta: UAD) p 260-5
[14] Awal S, Yani A and Amin B D *Jurnal Pendidikan Fisika Universitas Muhammadiyah Makassar* **4** 249-66
[15] Gaigher E, Rogan J M and Braun M W H 2007 *International Journal of Science Education* **29** 1089–110 https://doi.org/10.1080/09500690600930972
[16] Michaels S and O'Connor C 2012 *Talk Science Primer* (Massachusetts Avenue: TERC)
[17] Chen Y C, Park S and Hand B 2016 *Cognition and Instruction* **34** 100-47 https://doi.org/10.1080/07370008.2016.1145120