

Utilizing of TTW (Think-Talk-Write) instructional model in the use of pictorial riddle-aided student worksheets for students' critical thinking skills enhancement

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Abstract. The research aims for students' critical thinking skills enhancement through utilizing the TTW (Think-Talk-Write) instructional model in the use of pictorial riddle-aided student worksheets. This research used an experimental method with a single-group pretest-posttest design. The instrument consisted of the Learning Implementation Plan, worksheet and essay test. The research had implemented in Senior High School 1 Prambanan, Yogyakarta. The subject research used 48 students with two different groups (groups A and B). But both groups have the same treatment and the only difference is the instructor who carries out treatment in the class. Data analysis used the normality test, descriptive statistical test and Wilcoxon test. The normality test result presented that only the posttest data values for class A were normally distributed. The mean value of pretest to posttest for both classes increases significantly. The mean value of N-gain students in class A is 0.432 and class B is 0.406, which in the "moderate" category. Besides, the Wilcoxon signed-rank test result obtained sig. (2-tailed) value less than 0.05 ($0.00 < 0.05$). So, this research knows that utilizing the TTW model in the use of the pictorial riddle-aided student worksheet can influence students' critical thinking skills enhancement.

Keywords: *student worksheets, pictorial riddle, Think-Talk-Write, critical thinking skill*

1. Introduction

Education is absolutely needed for human beings who always go through changes [1]. In this disruption era, science and technology development demands educational reform to produce quality and intellectual human resources, one of them is critical thinking skills. [2], [3]. Critical thinking skills are one of the 21st-century skills that very important needed for students' intellectual. Every student has the potential to develop themselves into critical thinkers. Thinking activity in humans has a relationship with self-management pattern in that person [4].

Critical thinking skills are the ability of humans to receive a variety of information while analyzing the information with their basic knowledge. Human thought is the basis for combining ideas and directing some ways to problem-solving. Human can infer an event from their receiving and analyzing activities various information in their environment. Human also can verify an event by integrating conceptual knowledge with procedural abilities through their critical thinking [5]. In table 1, the indicator of critical thinking skills can be divided into 5 parts [6], [7].



Table 1. Indicators and sub-indicator of critical thinking skills.

No	Indicators	Sub-indicator
1	Elementary Clarification	Analysing information
2	Basic support	Observing and observations
3	Inference	Making induction and considering the results of induction
4	Advance clarification	Define terms dan consider definitions
5	Strategy and tactics	Decide an action

Teacher as a facilitator must be able to vary the instructional in the classroom as an effort to enhance students' critical thinking skills. Many instructional variations for enhancing students' critical thinking skills have been carried out by teachers and educational researchers, such as the use of PBL models aided by pictorial riddle methods [8] and inquiry models assisted by pictorial riddles [9], [10]. Variations in instructional development must use a plan that has been adapted to students needed and subject contents. The design of instructional innovation should adjust to increase the activities of students in the classroom. Students can improve learning outcomes and various kinds of instructional skills [11], [12].

Physics subject is one of the lesson contents in Senior High School. Physics learning allows students to develop analytical, inductive and deductive thinking skills in problem-solving related to natural problems [2]. The optical subject has one of the general sub-content in high school physics subject. This content is often found in everyday life, for example, magnifying glass and microscopes.

Based on observations in physics class at Senior High School 1 Prambanan, Yogyakarta; commonly students show some interest in new learning and hardly utilized in the classroom. For example, the teacher uses light polarization props in light class. Thus, the instructional design plans have been done and adjusted with the students' needed. This research utilizes a TTW (think-talk-write) instructional model in the use of pictorial riddle-aided student worksheets to enhance students' critical thinking skills. TTW is one of the cooperative instructional models for encouraging students to be more active in learning activities. This instructional model is more centered on students (student-centered) with a constructivism approach. This model makes activities variation like understanding the contents of the material (think), actively communicating to get the same understanding (talk) and writing down the results of the students' thoughts (write) [13], [14].

This TTW model can create a more pleasant learning atmosphere because it can increase students' activeness. It also arouses students' interest and their understanding of content subjects [11], [15]. A pictorial riddle is a form of visual media by presenting a puzzle or information through pictures or diagrams [16]. The pictorial riddle can develop learners' activities in group discussions about a given problem [12], [17]. The discussed problem can be presented illustration forms, draw forms or illustrated puzzle forms. This form can help students' understanding in the meaning of the abstract content subject. For example, the speed of light in optical content.

2. Reaserch method

2.1. Types and subjects

This research used an experimental method with Single-group Pretest-Posttest design. This research subjects used one group or experimental class with the pretest and posttest result. This research was carried out at Senior High School 1 Prambanan, Yogyakarta, Indonesia. The research sample used 48 students from 2 groups of XI grade within each group there were 24 students.

2.2. Design and instruments

This research used two experimental groups to know more about the influence of utilizing the TTW model in the use of pictorial riddle-aided student worksheets concerning students' critical thinking skills enhancement. The research design used the same pretest, treatment, and posttest in both groups. The

only difference is the instructor who carries out treatment in class. The treatment was carried out by the researchers themselves in Class A (XI Science 4) and Physics teachers in class B (XI Science 3). The object of this research was the pictorial riddle-aided student worksheet. It utilized the TTW model to learn optical devices with contents: magnifying glass and microscope.

These research activities included the observations of students, teachers, and environments around that school. This observation was made to know the students' condition from both the school environment and the environment in the classroom. The student worksheet design was carried out after knowing the results of the observation. This research used three instruments: Lesson Implementation Plan (RPP), pictorial riddle-aided student worksheet with TTW model, and 5 items test to measure students' critical thinking skills. The instrument validation was done by expert validators before implemented in both groups class.

2.3. Data analysis

Data collection technique used pretest and posttest items with 5 essays test as students' critical thinking skills measurement. The data collection result was analyzed descriptively and statistically. These data include pretest-posttest score and N-gain score. Students' enhancement in critical thinking skills before and after treatment are interpreted using N-gain score with the categories in table 2 [19]. N-gain score can be obtained through pretest and posttest values.

Table 2. Category n-gain score in cognitive ability test results.

Interval	Category
$0.7 \leq G < 1$	High
$0.3 \leq G < 0.7$	Moderate
$0 \leq G < 0.3$	Low

Data analysis techniques used Ms. Excell 2016, OriginPro 8 and SPSS 21.0 applications. SPSS analysis tests include the normality test, descriptive statistical test, and the Wilcoxon signed-rank test.

Hypothesis testing for the normality test is carried out at a significance of $\alpha = 5\%$. Hypothesis testing used are: H_0 : Data comes from normally distributed populations. H_1 : Data doesn't come from normally distributed populations.

Wilcoxon signed-rank test is another alternative way from Paired sample T-test. Commonly, this test is used to analyze data if the data is not considered normally distributed. Wilcoxon testing is carried out to determine whether there are differences in the average of two samples in pairs. Hypothesis testing from the Wilcoxon test was performed at a significance of $\alpha = 5\%$. Hypothesis testing used are H_0 : There is no difference in the pretest and posttest result in the category of critical thinking questions. H_1 : There are differences in the pretest and posttest result in the category of critical thinking questions.

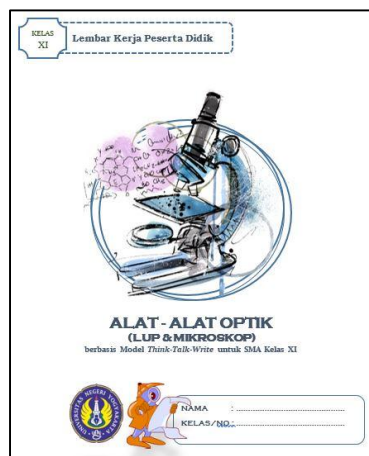
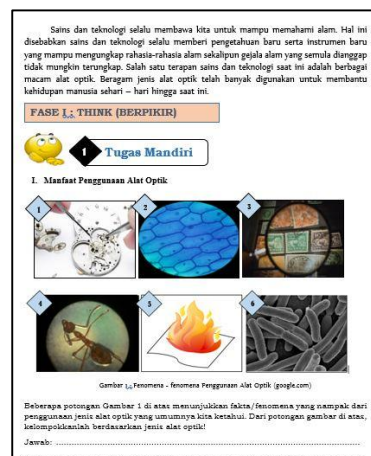
The analysis test with SPSS 21.0 uses the following basic decision making [18]: If the significance (α) is less than 0.05 then H_0 is rejected and if the significance value (α) is more than 0.05 then H_0 is accepted.

3. Results and Discussion

This research chose optical content with content sub-sections: magnifying glass and microscope. From this research known that pictorial riddle media can be merged with the TTW method. This research presents problems through puzzles or pieces of information in the stage of "think" activities. In table 3, all of activities teacher and student-guided with the pictorial riddle-aided student worksheet. In more detail, the pictorial riddle-aided student worksheet display presented in figures 1, 2, 3 and 4.

Table 3. Relation between treatment, learning activities and critical thinking skills variable.

Stages of TTW	Sub-indicator of Critical Thinking Skills	Activities	
		Teacher	Student
THINK	Analysing information	- Shows various information about the magnifying glass and the microscope and asks the function of the tool	- Answer the questions from the teacher and do student worksheets by themselves
TALK	Observing and observations	- Guide the student to do student worksheets	- Collect some information and discuss it with the group
	Making induction and considering the results of induction		- Organize information and explain concepts in accordance with the material
	Decide an action		- Deliver information from each of group discussion
WRITE	Define terms and consider definitions	- Guide the student to write term and definitions from discussion and presentation with their friends	- Do some reflection through write

**Figure 1.** The front page of pictorial riddle-aided physics student worksheets.**Figure 2.** First part of pictorial riddle-aided physics student worksheets in "Think" stage.

FASE II: TALK (BERBICARA)

2. Ayoo Diskusi...

Rusliah kelompok beranggotakan 4-5 orang, kemudian didiskusikan topik dari jenis alat optik yang telah tertera dari guru pendamping: yaitu sistem di bawah ini berdasarkan hasil diskusi kalian. Perencanaan di depan kelas.

Kelompok: Lup/Mikroskop

Jenis: Mata Berakomodasi Maksimum/Minimum

Prinsip optik:

Diskusikanlah bersama rekan-rekan Anda mengenai beberapa hal, antara lain:

a. Sebutkan manfaat apa saja yang Anda ketahui dari penggunaan alat optik yang telah kelompok Anda peroleh.

Jawab:

b. Bagaimanakah prinsip pembentukan bayangan pada alat optik yang kelompok Anda diskusikan? Bagaimanakah sifat bayangan yang terbentuk?

Jawab:




Figure 3. Second part of pictorial riddle-aided physics student worksheets in “Talk” stage

FASE III: WRITE (MENULIS)

3. Kesimpulan...

Dari hasil percobaan untuk tiap kelompok, Anda mendapatkan berbagai informasi terkait dengan lup dan mikroskop pada dua jenis akomodasi mata yang digunakan. Dengan menggunakan informasi yang kalian peroleh dan pahami, ulasilah kembali konsep dari keseluruhan kegiatan yang telah Anda lakukan di kelas.

I. Manfaat Penggunaan Alat Optik

LUP	MIKROSKOP

II. Sifat Bayangan yang Terbentuk pada Alat Optik

Alat Optik	Sifat Bayangan untuk	
	Mata Berakomodasi Maksimum	Mata Berakomodasi Minimum
LUP		
MIKROSKOP		

III. Rumus Matematis Perbesaran Angular pada Alat Optik

LUP	Mata Berakomodasi Maksimum	Mata Berakomodasi Minimum
Syarat		
Perbesaran Angular (M)		

Figure 4. Part of pictorial riddle-aided physics student worksheets in “Write” stage

This research was carried out to find out the students’ critical thinking skills in XI grade. After the instruments (Lesson Implementation Plan, student worksheet and item test) have validated by validator, the instruments implemented in both groups. Figure 5 presents the output result from research analysis data using Microsoft Excel 2016 and graphical interpretation using OriginPro 8.

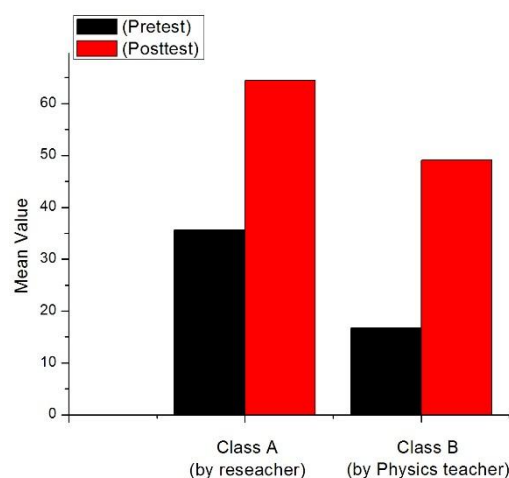


Figure 5. Graph of increasing the pretest and posttest mean value.

Pretest and posttest scores indicate the learning outcomes of students before-after the learning process treatment. The difference between pretest and posttest scores in class A is 28.86 and 32.31 in class B. This difference score presents the change in learning outcomes of class B students is higher than class A. Figure 5 presents the positive significance between changes in the pretest mean value before treatment (black) and the student’ posttest mean value after treatment (red) in both groups. From this enhancement, it known that there is a positive relationship between the pretest and posttest values in both class groups. It means that instructional treatment with the utilization of the TTW model in pictorial riddle-aided students' worksheet can influence students' critical thinking skills.

In previous research, the use of pictorial riddle-aided student worksheets has been done. This research utilizes inquiry models to enhance students' thinking abilities. In the research of Gultom and Sinuraya [10], Purwanto and Hasanah [4] and Arantika et al. [9] proves that pictorial riddle-aided student

worksheet with inquiry model can influence students' critical thinking skills. All of the three studies' result show positive significance due to the use of integrated pictorial riddle with inquiry models. After that, the pretest-posttest values data were analyzed to know the normality test result. The analysis of normality test output presented in table 4.

Table 4. The normality test analysis output in two class groups.

Score	Group	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Pretest	Class A	.210	24	.007	.910	24	.035
	Class B	.224	24	.003	.837	24	.001
Posttest	Class A	.125	24	.200*	.934	24	.117
	Class B	.248	24	.001	.825	24	.001

*This is a lower bound of the true significance

a. Lilliefors Significance Correction

Table 4 shows the significance values from two references: Kolmogorov-Smirnov and Shapiro-Wilk. This research uses the Shapiro-Wilk reference in normality test because the number of data is less than 50 participants. Table 4 can be present that significance values in both class groups are different. The data result was said to be normally distributed (symmetric) if the significance value greater than 0.05. Based on the hypothesis, it was found that the only class group A had a normal distribution in posttest value data ($0.117 > 0.05$) and the other data were not normally distributed.

After the normality test analysis, the pretest and posttest value was analyzed with the Wilcoxon signed-rank test. This analysis is a non-parametric statistical method which is generally used as an alternative to the Paired Sample T-test if the data have been known not normally distributed. Previously, the pretest or posttest data in both class groups were known that 3 data not normally distributed (in Table 4). Thus, the Wilcoxon signed-rank test can be used to find out whether there was an average difference between the two pairs of samples in both class group. The Wilcoxon test output is shown in table 5.

Table 5. Wilcoxon signed rank test results.

		N	Mean Rank	Sum of Ranks
Post-Pre	Negative Ranks	0 ^a	.00	.00
	Positive Ranks	48 ^b	24.50	11176.00
	Ties	0 ^c		
	Total	48		

a. Post < Pre

b. Post > Pre

c. Post = Pre

Table 6. Test statistic result^a.

	Pre-Post
Z	-6.032 ^b
Asymp. Sig. (2-tailed)	.000

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

Table 5 present the positive ranks value or the positive difference between the learning outcomes of both class groups is 48. This value shows that all students in both class groups got an increase in learning outcomes after treatment. Sig. (2-tailed) value in Table 6 presents 0.00 value. This value presents the significance "rank" value is smaller than 0.05 ($0.0 < 0.05$). Based on the hypothesis, it is known that the differences between the pretest and posttest values on the learning outcome show the change of ability

students' critical thinking. This significance value shows that utilize the TTW instructional model in the use of the pictorial riddle-aided student worksheet can influence students' critical thinking skills in both class groups.

N-gain value can be calculated through the pretest and posttest scores [18]. N-gain value presents an increase in the learning outcomes of both class groups. The following table 7 is the results of the descriptive statistical test output from both class groups.

Table 7. Data analysis of descriptive statistical test in the both class groups.

Group	N	N-Gain min	N-Gain max	Mean N-Gain	Standard Deviation	Category
Class A	24	0.12	0.15	0.433	0.207	Moderate
Class B	24	0.84	0.82	0.406	0.229	Moderate

Table 7 present the description of data analysis results from the N-Gain scores in both class groups. According to Hake [19] about the reference standard N-Gain score in Table 2, the mean value of N-Gain in both class groups has a values range between $0.3 < G < 0.7$. That range presents in the medium category for both class groups. So, it can be seen that the utilize of the TTW model in pictorial riddle-aided student worksheets succeeded in enhancement students' critical thinking abilities. This research was also strengthened by the research of Dewi and Bektiarso [8] as well as Gultom and Sinuraya [10].

4. Conclusion

Based on analysis results, utilizing the TTW instructional model in the use of pictorial riddle-aided student worksheets to both class groups can influence students' critical thinking skills enhancement. It is presented by positive significance change from pretest and posttest value data in figure 5. Furthermore, the positive rank value in Table 5 and the n-"gain" scores from two groups in the "moderate" category can also show students' critical thinking skills enhancement because of this research.

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