Improving Science Communication Skills Using Worksheets Based on Think-Talk-Write

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Abstract

Science communication skills are the process of conveying information or data from observations or experimental results to be known and understood by others. Student worksheets are printed teaching materials in the form of guides for carrying out an investigation or problem-solving activities concerning the basic competencies that must be achieved and are intended to streamline learning and help students master understanding, skills, and attitudes. Student worksheets developed in this study think talk write (TTW) based student worksheets. This study aims to determine the effectiveness of TTW-based student worksheets in improving science communication skills. The research method used was an experimental design with a randomized control group pre-test post-test. Data collection was done by giving 18 items of pre-test and post-test. Data analysis was performed using the N-Gain test and one-tailed t-test. Based on the results of this study, it was found that an increase in the results of the N-Gain test was 58.68%, while the results of the one-tailed t-test showed that the TTW-based student worksheets could help students improve their science communication skills

Keywords: Worksheets, think-talk-write, science communication skills

INTRODUCTION

Communication skills are believed to be the main structure in science education. Science communication can be used as material to create, cultivate, develop and expand knowledge. Students are expected to develop their communication skills by understanding the concepts and theories they find. Communication is also used to build a closer relationship between teachers and students to share knowledge, thoughts, and experiences (Fadly, 2017b; Patriot et al., 2018b; K. A. Sari et al., 2017; Urwani et al., 2018). This skill is one of the skills that need to be developed for learning science in the 21st century. Scientific communication skills are the process of delivering information or data from observations or experimental results to be known and understood by others (Fadly, 2019b; Varsavsky et al., 2014).

Based on a preliminary study to see the scientific communication skill in junior high schools, it was found that the average scientific communication skill of students was still below the completeness class grade, which was 67.4 of the grade 75 completeness score. Gathering information and writing skill are indicators that are still less. This data is strengthened by describing the learning process in class through interviews with one of the teachers. From the interview result, the teacher said that assessing students' skills had never been carried out through tests, but it was carried out based on observations. Most of the learning activities are also oriented towards knowledge transfer, with minimal activities that lead to a scientific process for knowledge construction. This pattern of activities causes the direct learning experience that students get only a few. By looking at this fact, a student worksheet is needed as a solution to facilitate learning activities directed at scientific processes and communication.

One of the efforts to develop students' science communication skills is to use learning tools that suit students' needs and abilities. One of them is by utilizing student worksheets. Among the advantages of using worksheet is 1) stimulating students to be active in the teaching and learning process, 2) training students to find concepts and develop them, 3) training students in developing skills and potential in students, 4) guidelines in following activities teaching and learning, and 5) helping students obtain notes from learning outcomes (K. A. Sari et al., 2017; Umbaryati, 2018).

The worksheet is a student guide that is used to carry out investigative or problem-solving activities that can be used for cognitive development exercises, as well as guidance for the development of all aspects of learning that are used to carry out investigative or problem-solving activities in the form of experimental guides or demonstrations (Givry & Tiberghien, 2012; Trianto, 2010). The worksheet is intended to help students carry out learning activities to master an understanding, skills, and attitude and help direct learning to be more effective and efficient (Majid, 2013; Sartika et al., 2020). For this reason, researchers will develop a worksheet based on think-talk-write (TTW) to solve these problems.

This TTW-based worksheet product consists of 3 main components, namely thinking, speaking, and writing. This component is also relevant to scientific communication indicators, namely, conveying opinions, ideas, gathering information, and processing data. Besides, the developed worksheet also has a distinctive characteristic, namely directing students to actively carry out various kinds of learning activities, for example, in discussion activities, guiding students to find multiple learning sources, directing students to write each result of the activity actively. The TTW-based worksheet will train students to learn and develop writing skills in a fluent language.

METHOD

This study aims to test the effectiveness of the TTW-based worksheet that has been developed. The research method used was an experiment with a pretest-posttest randomized control group design, using one each experimental class and one control class (Plomp & Nieveen, 2013; Riyanto, 2001). In determining the class and the research sample was carried out using the cluster random sampling technique (Fraenkel & Wallen, 2012), the selection was based on the population name list data collected together. The data was taken randomly and classified into experimental and control classes. Considering that the number of students at SMPN 2 Ponorogo grade 8th is approximately 284, the division is carried out using the Slovin formula (Hamdi & Bahruddin, 2015). A total sample based on calculation is 167 students consisting of 6 classes.

Students who have been determined as the sample are then given a pre-test, then given a worksheet with two different types based on the type of class, specifically for the experimental

class given worksheet based on TTW and the control class the worksheet, which is commonly used in schools. After filling out the worksheet, then the students were given a final test (post-test). Between the initial and final tests were made with the same characteristics but a change in the order of the question numbers was made. The evaluation questions consist of 18 items that refer to the 3 indicators of science communication skills studied. Then students are given a final test (post-test). Between the initial and final tests were made with the same characteristics but a change in the order of the question numbers was made. The evaluation questions consist of 18 items that refer to the 3 indicators of science communication skills studied. Then students are given a final test (post-test). Between the initial and final tests were made with the same characteristics, but a change in the order of the question numbers was made. The evaluation questions consist of 18 items that refer to the 3 indicators of science communication skills studied.

Table 1. Grid of science communication skills questions

No.	Indicator	Question Number	
		Pre-test	*Post-test*
1.	Ability to express opinions	5, 6, 7, 9, 11, 15	14, 3, 4, 9, 16, 17
2.	Ability to dig up information	10, 13, 21, 1, 14, 20	15, 8, 11, 1, 9, 20
3.	Ability to process data	16, 2, 17, 18, 19, 4	10, 2, 18, 21, 13, 3

The questions that have been tested are then analyzed using the two-tailed test and the one-tailed test to determine whether the increase in value is effective or not. Then the N-Gain test was carried out to determine the magnitude of the improve from pre-test to post-test (Arikunto, 2019). A qualitative descriptive analysis was also conducted to strengthen the worksheet results by analyzing students'e answers to the worksheet given during the treatment.

RESULTS AND DISCUSSION

Data collection to prove this increase was carried out by providing pre-test and post-test questions to students in the form of multiple-choice questions that were adjusted to indicators of science communication skills, namely the ability to express opinions, the ability to gather information, and the ability to process data. The research data were analyzed using the N-Gain and parametric statistical test, two-tailed t test, and one-tailed t-test. The test results are as follows.

Parametric statistics will test the pre-test and post-test students' results through the independent t-test to determine whether there is a difference in the value of the increase between the experimental and control classes. The hypothesis proposed is H_0: there is no significant difference between the experimental and control classes, and H_1: there is a significant difference between the experimental and control classes. The data from the independent t-test two-tailed are as follows.

Table 2 Two-Tailed T-Test Results

T-Test	Calculate Value	Significance Level	Test Decision
Experiment-control	0.003	0.05	H_0 is rejected

Table 2 shows that the significance value (t-tailed) is 0.003 <0.05. So it can be interpreted that there is a significant difference between the experimental and control classes. It is necessary to have a test that shows which improvement is better between the two. The statistical test that can prove it is through the one-tailed t-test. The hypothesis proposed is H_0: there is no significant difference in the increase in the experimental and control classes, and H1: there is a significant difference in improvement between the experimental and control classes. The data on the results of the one-tailed t-test is as follows.

Table 3 The results of the one tailed t test

One tailed	Value count	t-table (α.v)	Test decision
Experiment-control	-3.11361	-1,671	H_0 is rejected

The basis for rejection of the one-tailed t-test is H_0 is rejected if t count <-t table. T table at a standard deviation of 57 and a significance level of 0.05 is 1.671. t count shows the number -3.11361 <-1.671 with the decision that there is an increase in the experimental class is better than the control class. So it can be interpreted that using worksheets based on TTW effectively improves students' science communication skills.

After knowing that the students' scores were better in the experimental class, the pre-test and post-test data were generally calculated through the N-Gain test to see the improvement. The results are as follows.

Table 4 Classical N-Gain Test Results

	N-Gain score
Average	58.7%
At a minimum	22.7
Maximum	86.4

Table 4 shows the average increase in science communication by 58.7%. The increase in science communication skills is influenced by the use of the TTW-based worksheet developed. The worksheet is oriented towards the TTW learning model's principles, which helps students communicate their learning results orally and in writing in their language.

In addition to the classical N-Gain test, an N-Gain test is also carried out on each indicator, aiming to see the difference in each improvement indicator. The average pre-test, post-test, and N-Gain test for each indicator are as follows.
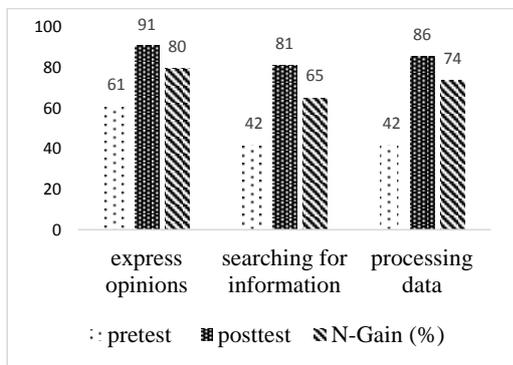

Figure 1. Graph of Science Communication Ability Improvement Indicator

Figure 1 shows that the indicator of the ability to express opinions obtained an average N-Gain of 80%. This shows that this indicator has experienced a high increase. On the indicator of the ability to dig information, the average N-Gain is 65%, it can be categorized as a moderate increase. While the indicator of the ability to process data, the N-Gain average was 74%. So the increase in this indicator is in the high category.

The ability to express this opinion requires students to convey what they already know based on previously known concepts. The following is an example of students' answers at the post-test in terms of expressing opinions.
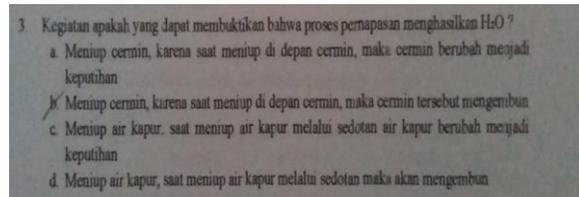

Figure 2. Students' Answers to Express Opinion Indicator

Based on Figure 2, it can be seen that students can convey their opinions correctly and are sure of the truth. Students may experience the obstacle in working on the questions above because their answers are almost the same, making them doubtful. If students choose the right answer but the explanation is wrong, they have less confidence in the chosen statement. However, it appears that students have been able to express their opinions well. This shows that students have good communication skills too (Fadly & Miaturrohmah, 2021; Oktaviani & Hidayat, 2010). Communication skills can make other people understand the conversation's contents and make other people convey their opinions.

The ability to express opinions to increase it is necessary adequate facilities, atmosphere, and media. This can be done through learning process-oriented to learners (Chang & Song, 2016; Nurhayati et al., 2012; A. N. L. Sari, 2020). Student-oriented learning can be done by discussing, presenting, and giving worksheets, as was done in this study. The TTW-based worksheet developed presents a think feature to help students improve their ability to express opinions.
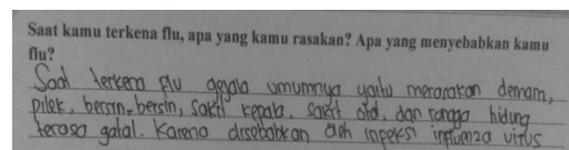

Figure 3. Student worksheet Answers at the thinking stage

The think feature invites students to think about answers based on their opinions and experiences. The two questions in this feature are the same concept. In this feature, the answers of students in the developed worksheet get the highest score. This is because contextual

questions make it easier for students to reason so that students can answer them easily because they have been experienced in everyday life. Science learning that raises contextual issues that occur in the environment can motivate students to argue or argue (Cobern, 2012; Fadly & Miaturrohmah, 2021; Giamellaro, 2014; Maknun, 2014). This answer shows that students can express their thoughts and feelings, expressed in a story and accompanied by knowledge and information.

Students' ability to explore information is the ability of students to understand the information they have obtained from the reading process and the extent to which they can understand what they find. The criteria for assessing the ability to explore information in this study are criteria such as students explaining and rewriting the information they have obtained in learning or describing the questions provided. Constraints that may occur in gathering information occur due to students who are always provided with information without knowing where the learning material comes from. Students are not accustomed to finding information independently and reading. The following is an example of the results of student assessments on indicators of gathering information.
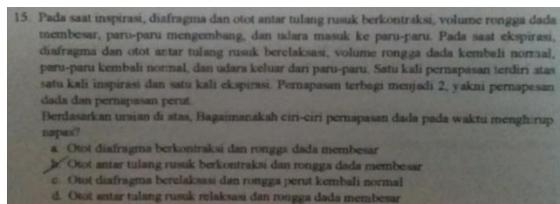

Figure 4. Students' Answers to Searching/Gathering Information Indicator

Figure 3 shows that students have been able to develop the ability to gather information well. These answers show that students understand and pay attention to the questions provided because the ability to explore information requires students to understand the meaning contained in a reading. By exploring the meaning in a reading, it is hoped that students will gain broader knowledge to practice their skills in communicating science. Abidin revealed that reading is a complex process of processing information. Among reading goals is to explore meaning or information from the reading (Nazilah et al., 2017; Velayutham et al., 2011). The TTW-based worksheet has a think & talk feature is applied to help improve the ability to gather information. One of the activities in this feature is analyzing learning material.
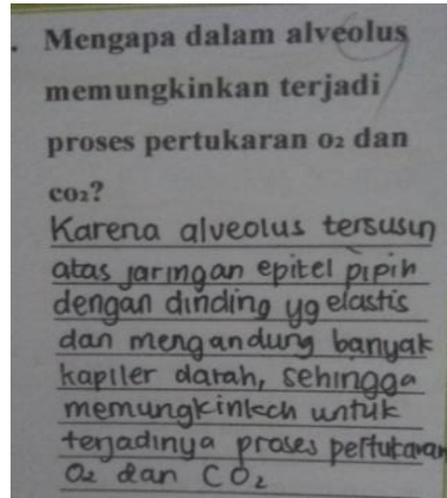

Figure 5. Student worksheet Answers at the think and talk stage

Figure 5 invites students to analyze respiratory organs based on their function. The think & talk feature is applied to discussion and reading activities and helps students express their opinions. At this stage, students are allowed to think critically in expressing their opinions. Students' answers in the picture above show that students can convey their opinions with critical answers. This answer shows that students can identify the relationship between the statements and concepts given in the questions and what they find in learning resources (Purwati et al., 2016; Taleb & Chadwick, 2016).

The last indicator is an indicator of the ability to process data. Data processing indicators have characteristics such as describing data in tables, reading and interpreting tables or graphs, changing data from tables, or presenting observations (Patriot et al., 2018a; Urwani et al., 2018). Indicators of the ability to process this data require students to provide conclusions based on the tables or images provided. Students who answer correctly mean that they pay attention, understand the tables and process them into an appropriate conclusion. The obstacle that may occur with this indicator is that students are not very careful reading and processing the table's data.

Figure 5. Students' Answers on Indicator 3

This figure shows that students have been able to process data well. This is indicated by students who choose the correct answer. Students have been able to read tables and describe them in sentence form. Science communication skills include reading graphs, tables, or diagrams from observations (Patriot et al., 2018b; Zulfa & Rosyidah, 2020) Science communication skills are also defined by communicating scientific knowledge or knowledge based on experiments and observations (Fadly, 2019a; Miaturrohmah & Fadly, 2020). Explaining the contents of the table in a sentence can make it easier for others to understand an experiment's results or observation.

Indicators of data processing can be improved by training students to write. Writing is an important part of science communication because it can train students to organize thoughts and find meaning developed as reflections for themselves or others (Fadly, 2017a; Sartika et al., 2020). Students are expected to describe and discuss a problem with this ability and put it in writing, including changing table data into descriptions that can help others interpret data more easily. The writing feature assists the ability to process data in this study. One of the activities in the write feature is as follows.
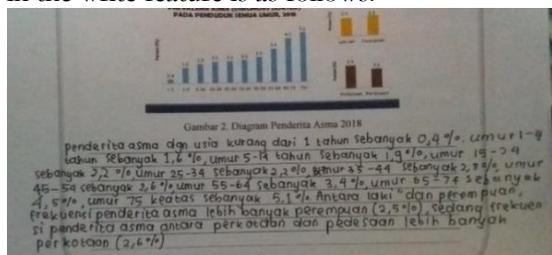

Figure 5. Students' worksheet Answers at the writing stage

The writing feature invites students to decipher the diagram into a sentence that makes it easier for others to understand it. From these

answers, it can be seen that students mention in detail each bar on the diagram. So that readers will easily understand the meaning of the diagram presented. This shows that students can describe the intent of the diagram clearly. The ability to process data can be seen from the ability to read tables, graphs, and diagrams of research results(Rahayu et al., 2018; K. A. Sari et al., 2017).

Student worksheets facilitate the teaching and learning process so that effective interactions are formed between students and educators that can increase student activity, including improving students' science communication skills. Because currently, schools in Indonesia are intensively trying to implement the 2013 curriculum at various school levels (Fadly & Jannah, 2020; Jannah et al., 2020). The main characteristic developed is using the scientific approach, which is the standard for the learning process, consisting of observing, asking questions, gathering information, associating, and communicating. To achieve the expected educational goals.

CONCLUSION

TTW-based worksheet effectively improves the ability to communicate science; this can be seen from, a) The results of the two-tailed test show that there is a significant difference between the control class and the experimental class b) The one-tailed t-test results show t-table at a standard deviation of 57 and the significance of 0.05 is 1.671 t-count shows the number -3.11361 <-1.671 with the decision that the increase in the experimental class is better than the control class, c) worksheet based on TTW is stated to improve science communication skills with the acquisition of an N-Gain value of 58.68 or in the moderate increase category.

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