

THE INFLUENCE OF STUDENTS' WORKSHEET WITH SCIENCE TECHNOLOGY SOCIETY BASIS TO STUDENTS' INTEGRATED SCIENCE PROCESSING SKILLS

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THE INFLUENCE OF STUDENTS' WORKSHEET WITH SCIENCE TECHNOLOGY SOCIETY BASIS TO STUDENTS' INTEGRATED SCIENCE PROCESSING SKILLS

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Abstract

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This research aims to determine the effect of students science activity based on Science Technology Society (STS) of student's integrated science process skills (ISPS). This research used true experiment design with Pretest-Posttest control design. Samples were taken by using simple random sampling technique from student population of class 7 SMP N 22 Semarang junior high school in academic year 2017/2018. The resulting class VII B as experimental class and class VII A as control class. The data were collected by using documentation, test, and observation method. The Result of correlation test between students activity based on STS to student's ISPS obtained from the observation result obtained correlation coefficient of 0,554. The correlation coefficient is categorized as moderate so it can be interpreted that the students activity based on STS gives a moderate effect on the student's ISPS. The effect of the students activity based on STS of the student's ISPS calculated from $r^2 \times 100\%$ is 31%, r is the correlation coefficient which states the correlation between students activity based STS and student's ISPS. The result of significance test of correlation coefficient value obtained $t_{count} > t_{table}$, its means that students activity based on STS give positive influence to student's ISPS. Based on the results of the study, it can be concluded that the students activity based on STS influenced the student's ISPS. N-gain calculation to measure the increase of the experimental and control classes showed that the increase of experiment class was categorized as medium, the increase of the control class was categorized as low.

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INTRODUCTION

Integrated Science Indonesian 2013 Curriculum is included in Article 77I section (e) Government Regulation Number 32 Year 2013. The subject is intended to develop students' knowledge, understanding, and analyzing ability to the environment. It is in line to Minawati *et al* (2014) who states that Science does not only related to concept, facts, and theory, but also related to a process of discovery. The effort to make integrated science as the process of discovery, development of science, and also the media to develop students' science processing skills (SPS). Muhafid *et al* (2013) explains that the use of SPS in learning process can build students' skills to obtain information.

The importance of SPS is also explained by Karamustafaoglu (2011) that SPS is the essentials and reflection of correct behavior from scientists' thought and researches in solving problems and planning experiment. However, students' problem solving skills still cannot be optimized. Their skills are still low, especially regarding to integrated science processing skills (ISPS). ISPS is the skills to solve problems or to do science experiment. In relation to this, Rosyada (2015) shows that students' ISPS does not exceed the criterion of good.

Similar result also obtained from the observation and interview to teachers regarding ISPS. The observation and interview in SMP Negeri 22 Semarang shows the students' practical ability only reaches 10%. Students is not capable to use tools and equipment, planning experiment, formulating hypothesis, and be active group discussion. However, the teachers have explained the procedures to use the tools. Most of the score of students' skills in their learning report have not exceeded the category of enough. The students also have difficulty in writing the observation data in table or graphic. The observation in SMP N 1 Magelang also shows that many students only play around during the practicum. Students only follow the procedure of practicum which have been served by the teachers.

The low ISPS status is caused by integrated science teaching which is mostly dominated by knowledge. The learning pattern also only touches the scope of thinking, while in the scope of skills is being untouched (Ningsih, 2015). If students' SPS is trained well, it will ease them find and apply the

concepts they obtain in their daily life (Saputri & Novi, 2014)

Students' worksheet can be the media to guide students in conducting experiment as well as to do the experiment along with enhancing their ISPS. It is in accordance with the research of Putri and Widiyatmoko (2013) which shows that the use of students' worksheet can improve students' science processing skills. According to Kurniawati *et al* (2013), science processing skills can develop with determining and developing facts regarding natural science.

Students' worksheet should begin with phenomenal and physical symptom's statement to students' daily life and the expected material/competence (Dini *et al*, 2013). Based on the the problems above, it is important to develop contextual students' worksheet with materials which are close to student' life. In accordance with Alfana *et al* (2015), students' worksheet can facilitate students to share their knowledge, not only memorizing the theory, but also making the learning process more meaningful. The developed topic and problems come from natural science problems in the environment which is relevant to science, technology, and society. In relation to this, the approach which can facilitate students' processing skills and knowledge of science and technology is Science, Technology, and Society (STS).

STS is an integrated approach of science and technology along with real issues in the society (Gusfaranie, 2015). The characteristic of STS is reviewing the content or science issues of the curriculum faced by the students in the real life which is related to technology (Destiani *et al*, 2015). STS is the development of constructivism in learning. According to Taufiq *et al* (2014), in constructivism, students form a new concept which is changed to become science through the process of interpretation, correspondence, representation, and elaboration. STS contains the formation of concept which involves integrated science processing skills. The content of students' worksheet with STS basis shall include the elements of ISPS.

STS-based students' worksheet is a students' worksheet which is filled with guidance/steps of discussion/practicum/observation in five steps,

including introduction, formation of concept, application of concept, validation of concept, and evaluation. The content of students' worksheet should include the contents which are related to science, technology, and society focusing on their impacts to social development. This students' worksheet should also possess the aspects of ISPS which is used for the practicum.

Science object and its observation is a chapter of science in Junior High School level which is learned in VII grade odd-term. It is also contained in the national examination. Science object and its observation is an introductory material for students to acknowledge natural science as a subject in VII grade; where the VII grade is the shifting period of students after graduating from Elementary School. The material of the chapter has integrated elements of biology, physics, chemistry, and Earth and outerspace. The use of STS-based students' worksheet in science has never been existed before; making the exploration to the material becomes less optimum.

Based on the explanation above, there should be a research regarding the influence of STS-based students' worksheet toward Junior High School students' science processing skills. This research focuses on whether STS-based worksheet is influential to students' ISPS skills? and How significant is STS-based worksheet to students' ISPS skills? The aim of this research is to unveil the influence of STS worksheet and its significance to students' ISPS skills.

METHODS

The sample of this research was taken using random sampling technique. This technique took sample randomly without considering the strata of the population with the same homogeneity. This research was done to VII B class with 36 total of students as the experiment class and 36 students of VII A as the control class. The independent variable of this research was STS-based students' worksheet. The dependent variable was the students' science processing skills. Meanwhile, the control variables was teacher, learning materials, test instrument, and the duration of learning process.

The instruments of the research were exercises sheets and science processing skills' observation sheet. The analysis of data was quantitative and descriptive analysis. The quantitative analysis for

the reliability, item discrimination, item difficulty, two variances analysis test (homogeneity of sampling class), normality test (observation, pretest, posttest), and correlation test to know the relation between STS-based students' worksheet with ISPS. The N-gain analysis was used to reach the improvement of experiment and control class in the cognitive aspect. N-gain can be discovered by using this formula:

$$g = \frac{SCORE_{posttest} - SCORE_{pretest}}{SCORE_{maximum} - SCORE_{pretest}}$$

RESULTS AND DISCUSSION

The analysis of data was done to answer the hypothesis. The analyzed data were ISPS score and students' cognitive learning outcome. The ISPS score of the students' ensure the homogeneity test, normality test, and correlation test between experiment and control class. The data of cognitive learning outcome was analyzed with N-gain test. Based on the normality test, the data of experiment class and control class were considered as normal.

The result of analysis of ISPS, showing the average score on the 1st meeting to 2nd meeting of experiment class and control class can be seen in Table 1.

Table 1. ISPS Categories of Students

Categories	Experiment	Control
Very Good	17%	-
Good	66%	78%
Fair	17%	22%
Poor	-	-

Table 1 shows the percentage of achievement category of experiment and control class. Students of the experiment class reached 3 ISPS categories of very good, good, and fair. Meanwhile, students in the control class were only in the good and fair categories.

The analysis of students' average ISPS score in experiment and control class can be seen in Figure 1.

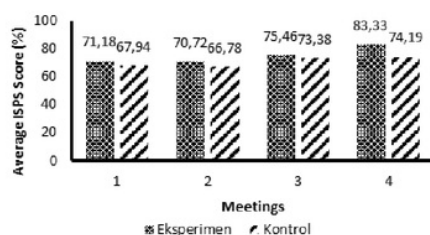


Figure 1. The Percentage of Average ISPS Score in Experiment and Control Class in each Meeting

Based on Figure 1, the ISPS of experiment and control class was increased with experiment class experiencing higher increase than control class.

The result of the research obtained that STS worksheet influences student ISPS. The influence can be seen in Table 1. The students in experiment class achieved very good category while the control class only does not get that. The result, as portrayed in Figure 1, shows that the percentage of average ISPS score' increase in the experiment class was higher than the control class. It is because of the use of different treatment to both classes. The experiment class got STS worksheet while the control class only used teachers' book. In Sari *et al* (2014), class which is assisted with students' worksheet can make students more active in the independent learning activity or in developing their science processing skills. The difference of result supports the statement of Asmarani (2013) and Santoso (2013) that students' psychomotor competence in the class with STS worksheet was better comparing to class without the worksheet. For the information, competence of psychomotor is included into ISPS.

To know the influence of STS-based worksheet to students' ISPS, the data of students' ISPS observation was measured using biserial correlation.

The measurement of correlation test to the ISPS observation sheets of experiment and control class can be seen in Table 2.

Table 2. Correlation Test (r) of STS-based students' worksheet to students' ISPS score

Meetings	Y_1	Y_2	S_y	r	KD
1	2.30	2.20	0.49	0.13	2.00%
2	2.20	2.07	0.45	0.17	3.00%
3	3.00	2.00	0.46	0.31	10.0%
4	3.00	2.50	0.52	0.55	31.0%

Table 2 shows the relation (r) between STS-based students' worksheet to ISPS. The best interpretation happened in the fourth meeting in the score of 0.554. The interpretation of r value is categorized as medium, that it can be said that STS-based students' worksheet influences students' ISPS. The total of the influence was measured by coefficient determination (CD). The result of the analysis obtained the score of $CD = 31\%$. The CD score shows that the treatment of the experiment improve students ISPS in 31%.

The r value to measure the significance of correlated coefficient used t-test. The analysis of t-test to measure the significance of correlated coefficient can be seen in Table 3.

Table 3. The Significance of Correlated Coefficient (r) of students' worksheet to students' ISPS

Meetings	r	N	t_{count}	t_{table}	Note
1	0.13	72	3.10	2.00	H_a accepted
2	0.17	72	3.53	2.00	H_a accepted
3	0.31	72	4.93	2.00	H_a accepted
4	0.56	72	6.69	2.00	H_a accepted

Table 3 showed that the obtained score was $t_{count} > t_{table}$; thereby, H_a was accepted and showed that there is a positive influence between STS worksheet to students' ISPS.

The statistical analysis in Table 2 regarding coefficient determination shows that in this research, STS-based students' worksheet influenced students' ISPS since the first meeting to the fourth in the score of 2%, 3%, 10%, and 31%. It means that the worksheet does not influence in 100% to students' ISPS. There are other factors to that, which are learning model and method as well as internal factor of the students and class condition. Each model of learning has different characteristics which can be supported to improve ISPS.

The learning model of the teacher will influence students in understanding ISPS in learning. It is strengthened by Ilmi (2012), that there is a significant difference of SPS in the experiment class using guided discover and the conventional learning in control class. Syafii (2014) also shows the similar result that

question based discovery learning can increase SPS. Sari (2015) also expresses that guided inquiry model can improve students' science processing skills. The other factor is the learning method using lecture, discussion, and practicum will give different influence to students' ISPS. The practicum learning method can improve ISPS compare to other method. It is in line with Muamar (2017), that experiment can increase the level of students' processing skills and learning outcome. In the practicum, the students were demanded to activate their abilities, whether it is cognitive, psychomotor, and affective as well as the social ability. These abilities are the part of science processing skills.

Analysis of ISPS in Each Aspect

There are six aspects of ISPS in this research. These following explanation will elaborate each aspect of ISPS.

1. Acknowledging Variable

The result of the average score analysis of experiment and control class in each meeting can be seen in Figure 2.

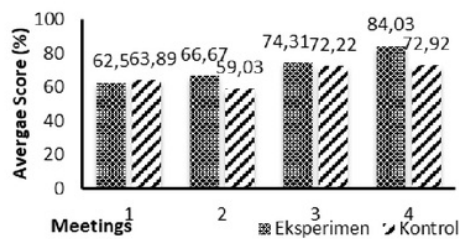


Figure 2. Aspect of acknowledging variables

Figure 2 shows that in each aspect of acknowledging variables, experiment class experienced an increase which was higher than the control class. In the second meeting, the control class experienced a decrease. It shows that experiment class master the material better than the control class. In conclusion, STS worksheet helps the students knowing variables with the explanation of the definition, types, and the exemplification of variables. This worksheet also contains the activity which can train the students to know variables in discussion.

To obtain the influence of the treatment in the observation, biserial correlation was done. The analysis shows that the first to fourth meeting obtained the ρ score of 0.44, 0.41, 0.48, and 0.31. The analysis shows that the highest influence occurred in the third meeting. Then, the coefficient

significance with t calculated test shows that $t_{count} > t_{table}$; thus, the H_0 is rejected and H_a is accepted. The result shows that STS-based worksheet can influence the students significantly regarding acknowledging variables.

The result of the observation shows that the use of STS-based students' worksheet can give positive and significant influence to the acknowledgment of variables in the experiment class. A research conducted by Lestari *et al* (2017) shows that the use of students' worksheet on separation materials which can improve every aspect of SPS in the N-gain category of medium.

2. Arranging Hypothesis

The analysis of average score of arranging hypothesis of experiment class and control class is in Figure 3 as follows.

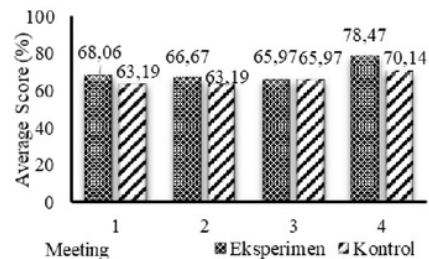


Figure 3. Average score of arranging hypothesis

Figure 3 shows that the aspect of arranging hypothesis in the experiment class increased in the fourth meeting. The class has higher percentage than control class. The mastery of arranging hypothesis is better in the experiment class than in the control class. Arranging hypothesis needs well understanding of a concept. Hypothesis is a temporary prediction to research objectives. Hypothesis is the initial state of the students to manage information as a knowledge. Curiosity of information will be the stimulant and motivator to students to arrange hypothesis. In this research, the use of STS-based students' worksheet can activate students' activity due to the practicum and discussion. The activeness of the students is caused by some factors, like the delivery of the learning process which requires more questions, answers, and actions (Izzati *et al*, 2013).

The influence of the findings in analyzing hypothesis was resulted from biserial correlation. The result of the analysis from the

first to the fourth ρ scores were 0.48, 0.47, 0.86, and 0.41. The result showed the higher influence happened in the third meeting. After that, coefficient significance test with t correlation test showed that the first to fourth meeting obtained $t_{\text{count}} > t_{\text{table}}$; thereby, H_0 is rejected and H_a is accepted. It shows that STS-based students' worksheet give positive influence to the aspect of arranging hypothesis.

The analysis of correlation strengthens the statement that there is a positive and significant influence from STS-based students' worksheet to the aspect of arranging hypothesis.

3. Make Operational Definition

The analysis of average score in making operational definition in experiment class and control class is portrayed in Figure 4.

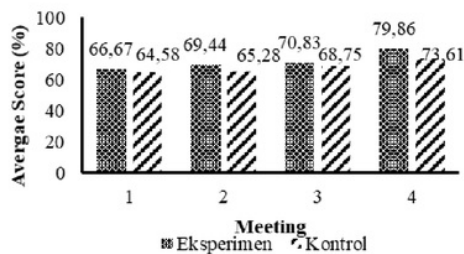


Figure 4. Average Making Operational Definition score

Figure 4 shows that from the first to the fourth meeting, experiment class experienced a rise. The percentage of the class was higher than control class. The achievement of the students in experiment class in mastering indicator on the aspect of making operational definition is better than the control class. Students who master this aspect can master other indicators, like asking questions of how to measure variables in an experiment, choosing appropriate lab tools, correct note taking, and identifying determining factors in experiment. The aspect of making operational definition as well as the attribute will not cause multiple interpretation. The objective to make operational definition is to make students know what should be done and be observed in an experiment. Students should do critical review to some literatures and the worksheet. Critical review is an activity of analysis to obtain ideas, explanation, supporting data, and support of the main idea (Khusniatai & Pamelasari, 2014). Critical review of literature can help students in making

operational definition of variable which do not make multiple interpretation, be clear, and able to show the correct and effective way to experiment.

The result of this aspect was also analysed with biserial correlation test to discover the relation between STS worksheet and students' ISPS. The result of the analysis showed that from the first to fourth meeting, the ρ scores were 0.29, 0.43, 0.50, and 0.44. The analysis showed that the highest influence occurred in the third meeting. Then, there was a coefficient significance score with t correlated test on the first meeting which scored $t_{\text{count}} < t_{\text{table}}$; thereby, H_0 was accepted. The second to fourth meeting obtained the score of $t_{\text{count}} > t_{\text{table}}$; therefore, H_0 was rejected and H_a was accepted. It shows that there is a positive and significant influence of STS worksheet to students' ability in making operational definition.

The result of the research showed that there is a significant influence between STS worksheet to students' ability in making operational definition. Apart from the less influential status of the first meeting, this method gave changes in Figure 4 that the experiment class has higher score than control class. This aspect was implicitly given in the steps of practicum guidance. Thus, students have to understand and apply all procedures explained in students' worksheet to make a better operational definition (Handayani, 2016).

4. Conducting Experiment

The analysis of the average score of conducting experiment in both class can be seen in Figure 5.

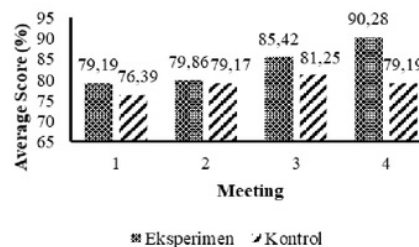


Figure 5. The average percentage score of conducting experiment

Figure 5 shows that from all meetings, the achievement of the aspect of conducting experiment was increased in both classes. The

increase to this aspect is strongly influenced by the learning process. As in Widyatmoko & Pamelasari (2012), in order to make learning process easy, impressive, and memorable, there should be a concrete, observable, and direct activity. STS-based students' worksheet presents discussion and practicum in contextual way which can give students direct experience to try the learning process. It gives them a concrete learning which improve their understanding.

The biserial correlation of the aspect shows that in four meeting, the ρ scores were 0.55, 0.69, 0.56, and 0.39. ρ is a correlation coefficient between STS-based students' worksheet to the aspect of conducting experiment. It is also the symbol of correlation analysis of rank Spearman. The analysis shows that the highest influence happened in the second meeting. The significance test of the coefficient scored $t_{count} > t_{table}$; thereby, H_0 was rejected and H_a was accepted. It shows that STS-based worksheet positively and significantly influences students through the experiment.

The analysis of the influence is due to the guide in the worksheet which helps the students to do the experiment. Many experiment involve activity like observing, measuring, categorizing, predicting, asking questions, arranging hypothesis, planning experiment, conducting experiment, analyzing and interpreting data, planning concept, concluding, and communicating the result of the experiment (Dewi, 2012). Many part of experiment involves other aspect, especially basic SPS and integrated SPS. It becomes the challenges for the students to master the SPS of the experiment well.

5. Interpreting Data

The analysis of the average score of the aspect interpreting data in experiment and control class can be seen in Figure 6.

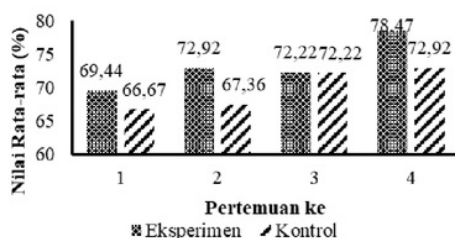


Figure 6. Average score of interpreting data

The difference of the achievement in the experiment and control class was very significant. The ability of the students in interpreting data is the

ability to analyze data from the experiment. It is an indicator which measure students' ability of showing the relation between variables, measuring data of experiment's result correctly, make a table or graphic, and identify the relation between variable. STS-based students' worksheet give exercises and activities which can train students' independence in interpreting data. According to Pratidina *et al* (2016), students who have strong interest to the chapter of lights based on SPS can discover concepts independently.

The biserial correlation test to this aspect scored ρ of 0.54, 0.40, 0.46, and 0.48 in four meeting with fourth meeting as the highest influenced day. Then, significance test of correlation coefficient with t correlation test shows that $t_{count} > t_{table}$; thereby, H_0 was rejected and H_a was accepted. It shows that STS-based worksheet positively and significantly influences students interpret data.

The students in the experiment and control class master the indicators of interpreting data well. It can be seen in Figure 6, specifically comes from the observation of both class. Apart from the treatment, the worksheet also contains with questions related to interpreting the data of experiments.

6. Making Conclusion

The analysis of average score in making conclusion in experiment class and control class is portrayed in Figure 7.

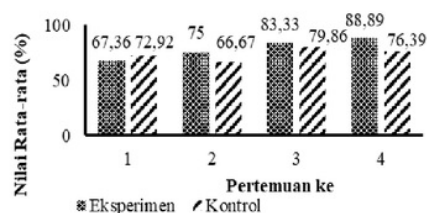


Figure 7. Average score of making conclusion

The experiment class scored better in making conclusion than the control class as in Figure 7. It cannot be separated from the learning process in the experiment class. The class with STS worksheet was being explained about the relation between science and technology, as well as its impact to the society. Making conclusion is related to the ability to answer hypothesis. This ability is strongly related to the ability of interpreting data. This

aspect teaches the students to make rational decision of practicum's result which have strong relation with variable and ability to produce good language as well as using appropriate concept.

The influence of the treatment of this research to students' ISPS were measured with biserial coefficient. The analysis of four meeting scored ρ values of 0.43, 0.18, 0.71, and 0.24 with the third meeting as the highest score. Meanwhile, the t correlation tests in the second and fourth meeting scored $t_{count} < t_{table}$; thereby, H_0 was accepted. Meanwhile, the third meeting scored $t_{count} > t_{table}$; thereby, H_0 was rejected and H_a was accepted. It shows that STS-based students' worksheet give positive influence to the aspect of arranging hypothesis.

The result of correlation test shows that students' worksheet provides betterment to students' ability in making conclusion in the first and third meeting due to some factors. These factors are students had difficulties in reporting the result of practicum with giving incorrect answers to the hypothesis. They tend to write the result of the practicum; instead of the conclusion of the hypothesis. They are categorized as good if they can master the indicators of making conclusion. The percentage of Figure 7 shows that experiment class had higher score than the control class in each meeting, showing that the treatment worked well.

The Influence of STS based Worksheet on the Kognitive Learning Achievement

The data of pretest and posttest is the secondary data to show the improvement of experiment and control class using N-gain test. The result of N-gain test can be seen in Table 4.

Table 4. The average students' cognitive learning outcome

Classes	N	Mean of Pretest	Mean of Posttest	N-gain	N-gain criteria
Experiment	36	44.71	63.34	0.338	Medium
Control	36	47.57	57.98	0.198	Low

The result of Table 4 shows that the improvement of students' cognitive learning in the experiment class was higher than the control class. The cognitive learning result in this research was analyzed from posttest and pretest to find its improvement. The N-gain analysis in Table 4 shows that the improvement of experiment class was categorized as medium. Meanwhile, the control

class was low. It shows that the treatment guarantees better cognitive result from the learning process.

STS-based students' worksheet is developed from constructivism learning theory, where students dig and find experiences to learn. The stages of the STS were made to help students in building their knowledge. STS can train and direct students to do science process in involving processing skills which consists of cognitive, manual, and social ability. The students also consistently did the worksheet to train and improve their cognitive skills. This statement supports Gusmedi (2013), that the average score of experiment class is better than the control class. It also supports Siagian (2014) who says that there is a difference of outcome from STS approach to ordinary approach of learning.

CONCLUSION

Based on the result and discussion, it can be inferred that STS-based students' worksheet is able to give positive and significant influence to students' ISPS. The highest number of influence occurred in the fourth meeting with the total score of 31%.

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