Journal of Educational Sciences
Journal homepage: https://jes.ejournal.unri.ac.id/index.php/JES

P-ISSN 2581-1657
E-ISSN 2581-2203

# Implementation of Project Based Learning Student Worksheets to Improve Students' Science Process Skills on Environmental Pollution in High Schools

**R. Razak Setiawan*, Suwondo, Wan Syafii**
*Magister of Biology Education, Universitas Riau, Pekanbaru, 28293, Indonesia*

**ARTICLE INFO**

*Article history*:

Received: 30 Aug 2020
Revised: 15 Jan 2021
Accepted: 15 Jan 2021
Published online: 24 Jan 2021

*Keywords:*

LKPD based on project based learning
Science Process Skill
Environmental Pollution

**A B S T R A C T**

This study aims to determine the improvement of students' science process skills through the application of Project Based Learning based LKPD on environmental pollution material for Class X Senior High School. This research was conducted at MAN 1 Kuantan Singingi. The method used in research is development research (Research and Development). Sources of research data came from 25 students of class X IPA 3. Research design using one group pretest posttest only. Data collection obtained from the preetest and posttest results of the student's Science Process Skills instrument. The results showed that the students' science process skills experienced an increase in the posttest results, from 63.5 to 83.5 with a medium increase (N-Gain 0.54). From the research results, it can be concluded that LKPD based on project based learning can be used as a medium for learning biology in high school.

## 1. Introduction

The National Education System functions to develop capabilities and shape the character and civilization of a nation with dignity in the context of the intellectual life of the nation (Departemen Pendidikan Nasional, 2003). Education is a form of human culture that is dynamic and full of development, therefore changes or developments in education are things that should occur in line with changes in the culture of life.

Environmental problems that still occur today, especially in the Regency of Kuantan Singingi, are the rampant illegal mining of gold (PETI) which can cause environmental pollution. PETI's activities in Kuansing are thought to have resulted in water pollution from the Kuantan River, Singingi River, tributaries whose water flows to residential areas, and irrigation dam water which is already a concern. Based on research conducted by Yulis. (2018) along the river of

* Corresponding author.
E-mail: rajarazak11@gmail.com
Doi: https://doi.org/10.31258/jes.5.1.p.130-140

Kuantan Singi Regency, it has been found that mercury levels are quite high, this will endanger the life of aquatic biota, and have an impact on humans due to consuming fish that has accumulated mercury.

Learning biology is a science that is closely related to everyday life, through biological concepts will greatly assist students in solving problems related to the natural surroundings. In learning biology students must be taught to be able to think, make rational choices and analyze problems that exist in everyday life. Biology learning also emphasizes providing direct experience to develop competencies so that students can explore and understand the natural surroundings. By trying to find solutions to problems independently, it will provide a concrete experience that can be used to solve other similar problems, because these experiences provide special meaning for students. At present, most schools do notteach students to think critically or solve problems (Ningsih et al., 2020). Learning that raises problems factually can increase long-term retention of knowledge and actual application of knowledge. (Elaine et al., 2016). According to Lufri et al. (2020) Problem-based learning can improve students' Biology competence.

Science learning is not only learning how to remember material, but also mastering science process skills (KPS) and applying them in scientific work (Jeenthong et al., 2014). KPS in learning science (Biology) is an important category, because by developing student KPS, learning is no longer focused on the final result, but also on the process (Fikriyah et al., 2015). Students can better understand the material being taught, because they take an active role in the learning process, so that KPS indicators also develop.

One alternative that is expected to assist in the implementation of learning and can involve students actively is by using project-based learning (PjBL) -based LKPD. PjBL-based LKPD is a LKPD that is structured on a project-based basis (project based learning). The problems contained in the LKPD are oriented towards contextual problems, so that students are aware of their usefulness in everyday life (Afdareza et al., 2020). This LKPD uses a project as material to find and help obtain the knowledge needed by students. Learning using the PjBL model is an alternative learning that can be used not only to assess cognitive aspects, but also student performance (Hayati et al., 2013). The advantages possessed by the project-based learning model are able to increase students' curiosity, problem-solving abilities and cooperative attitudes, and resource management skills (Munawaroh et al., 2013).

PjBL based LKPD, students can be directly involved in the learning process, because of a project that is done either individually or in groups. This is in line with Rose et al. (2014) statement, that PjBL learning provides opportunities for students to learn and work together in solving problems, then present their work to the audience for presentation. Many simple projects can be carried out by students, so that students are more active in learning and able to solve daily problems related to the material (Deta et al., 2013). The process of project-based learning can make it easier for students to understand the material, because

students directly apply their knowledge into a project they compile. The project will make it easier for students to remember the concepts that have been obtained (Sumarni., 2013).

The development of project-based learning LKPD in science learning (Kharisma et al., 2020) will be carried out well if it is carried out in accordance with the learning steps. Project-based learning steps were developed by Lucas. (2005), there are six learning stages, namely: (1) star with the essential question, (2) design a plan for the project, (3) create a schedule, (4) monitor the stuents and the progress of the project, (5) asses the outcome, (6) evaluate the experiences.

The project based learning application is very effective because it focuses on creative thinking (Gafur et al., 2020), problem solving and interactions between peers to create and use knowledge. (Asan et al., 2005). In project-based learning, it needs to be implemented by the teacher in a combined learning method, the teacher can work together with students in planning and project learning (Mitchel et al., 2009). Based on the above problems, it is necessary to carry out a PjBL-based LKPD development design research on environmental pollution material to improve students' science process skills.

## 2. Methodology

This research is a research development (Research and Development) which aims to formulate and produce LKPD based on Project Based Learning (PjBL) on environmental pollution material. The development model used is the ADDIE Model which consists of the Analysis, Design, Development, Implementation and Evaluation stages (Dick et al., 2005). The place for developing LKPD is in the Master Program in Biology Education, Faculty of Teacher Training and Education (FKIP), University of Riau. Meanwhile, research in the implementation of the PjBL-based LKPD was carried out in MAN 1 Kuantan Singingi. The research was conducted in January - February 2020.

The types of data obtained consist of primary data and secondary data. Primary data is data obtained from data sources, while secondary data is data obtained from previous studies. Primary data collected includes: (1) data on environmental problems that exist in the vicinity; (2) Students' science process skills based on the pretest and posttest scores from the results of the LKPD implementation. Secondary data collected is in the form of supporting data on environmental issues and problems obtained from various sources such as: journals, research reports, books, and other sources that are relevant and accountable. The population in this study were students of class X in MAN 1 Kuantan Singingi amounting to 3 classes, the samples were determined using purposive random sampling. The research design used was the One Group Pretest-Posttest design model.

Observations made in this study were to make observations on students who participated in the learning activities carried out. This observation sheet contains

predetermined science process skills. The following is the grid of the science process skills observation sheet can be seen in Table 1 below.

Table 1. Instruments and indicators for the Assessment of Science Process Skills

| Process Skills | Indicator |
|---|---|
| Asking question | a. Asking what, why and how<br>b. Ask for an explanation<br>c. Asking questions that have a hypothetical background |
| Formulate a hypothesis | a. Knowing that there is more than one possible explanation for an event<br>b. Realizing that an explanation needs to be verified |
| Carry out Experiments | a. Carry out work procedures that have been made<br>b. Using tools and materials according to their function<br>c. Collect and record data<br>d. Get involved directly in every step of the activity |
| Apply the concept | a. Using the concepts that have been learned<br>b. Use concepts in new experiences to explain what's going on |
| Communicate | a. Prepare and submit reports systematically<br>b. Describe the results of the experiment or research<br>c. Discuss the results of activities regarding a problem or an event<br>d. Active in presentation activities (questions and answers and comments) |

Adapted and modified from Bundu, (2006); and Nurohman, (2010).

The instrument of science process skills is calculated by (a) Recapitulating each item of the student's science process skills observation sheet based on the observer's assessment, (b) Calculating the total score of meetings, (c) Calculating the average score of each meeting, (d) Changing the accumulated value of the results observation of science process skills of each student into a percentage based on the equation:

$$X = \frac{\Sigma Si}{s} \text{ x } 100\ \%$$

Source: (Arikunto, 2006)

Information: X = Percentage of scores
$\Sigma Si$ = Total score obtained
s = maximum score

The results of the percentage of science process skills are then converted into qualitative data using criteria according to Purwanto (2002) as in Table 2.

Table 2. Scale of Science Process Skills Category

| Mastery level | Category |
|---|---|
| 86-100 | Very good |
| 76-85 | Good |
| 66-75 | Enough |
| 55-65 | Less |
| ≤ 54 | Very less |

(Purwanto, 2002).

## 3. Results and Discussion

This research is a research development (Research and Development) which aims to formulate and produce LKPD based on Project Based Learning (PjBL) on environmental pollution material. The development model used is the ADDIE Model which consists of the Analysis, Design, Development, Implementation and Evaluation stages (Dick et al., 2005).

The existence of Student Worksheets is very helpful for students in understanding various basic concepts of the material by further developing problem solving skills. This is supported by the statement put forward by Paidi (2011) that the complex problems that exist in LKPD have the potential to train students' abilities to solve authentic problems and find alternative solutions (Figure 1).

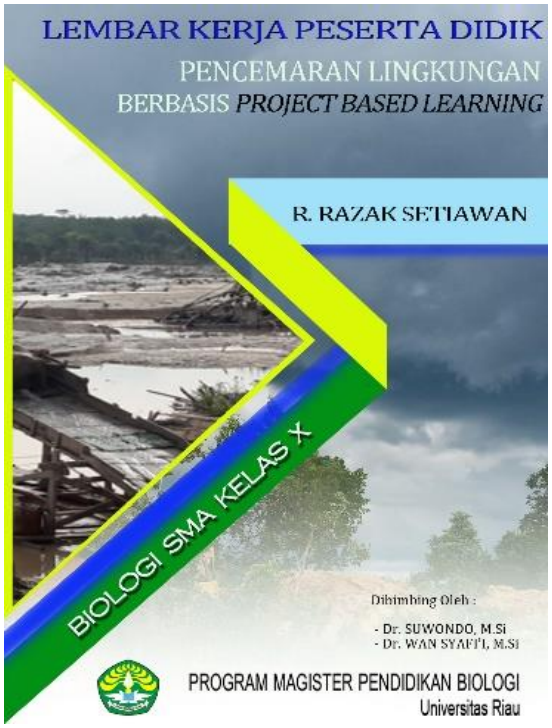


Figure 1. Cover Of Project-Based Learning Student Worksheets On Environmental Pollution Material

Project-based learning worksheets for students developed with problems in the environment can foster students' interest in learning them. According to Wahyudi et al (2014), students will easily understand learning materials that use LKPD which presents various examples of problems in the surrounding environment, this is because the LKPD triggers the interest of students and feels not bored with the material presented. according to Sujiono (2014) The use of problem-based teaching materials can also improve students' science process skills.

### *Results of Students' Science Process Skills*

Science process skills are skills that lead to the growth and development of a number of skills. In the process of learning science at school students will find many useful new things, namely in the form of concepts, facts and attitude development so that learning becomes more meaningful and students' thinking skills develop. Active and creative student involvement in the learning process is emphasized to measure student KPS, so that KPS functions as a driving wheel in the discovery and development of attitudes and values in obtaining learning outcomes. Research by Janbuala et al. (2013), found that scientific learning can improve student KPS. Learning science not only develops student KPS, but students also gain learning experiences that they experience to develop their competence (Syafaren et al., 2019).

The results of students' science process skills had a significant difference between before and after the implementation of LKPD based on Project Based Learning on environmental pollution material. The value of the results of students' science process skills can be seen in Table 3 below.

Table 3. Results of Students' Science Process Skills Based on Pretest and Postest Values

| ***Pre-Test*** | | ***Post-Test*** | |
|---|---|---|---|
| **Score** | **Criteria** | **Score** | **Criteria** |
| 63,5 | Enaugh | 83,2 | Good |
| | N-Gain | 0,54 | Medium |

The increase in student KPS achievement can be determined by calculating the N-Gain value. The calculation results obtained using N-Gain are with a score of 0.54 in the medium category. Then the pretest and posttest results are grouped into 3 categories. The average increase in students' pretest and posttest results about KPS was in the range of 0.4 - 1.0 with medium to high categories. This means that the application of Project Based Learning based LKPD on environmental pollution material can improve students' science process skills. To clarify the description above, the percentage increase in posttest results on pretest students of class X. IPA 3 is presented in Table 4 below.

Table 4. N-Gain Test of Pretest and Postest Results

| **Sample** | **Percentage of Increase** | **Category Improvement** | **Total students** | **Percentage of Total Students (%)** |
|---|---|---|---|---|
| X. IPA. 3 | (g) < 0,3 | Low | 1 | 4 |
| | 0,3 ≤ (g) <0,7 | Medium | 18 | 72 |
| | (g) > 0,7 | High | 6 | 24 |
| | **Total** | | **25** | **100** |

Based on Table 4. Increasing science process skills with a gain score can be shown in the diagram as follows.

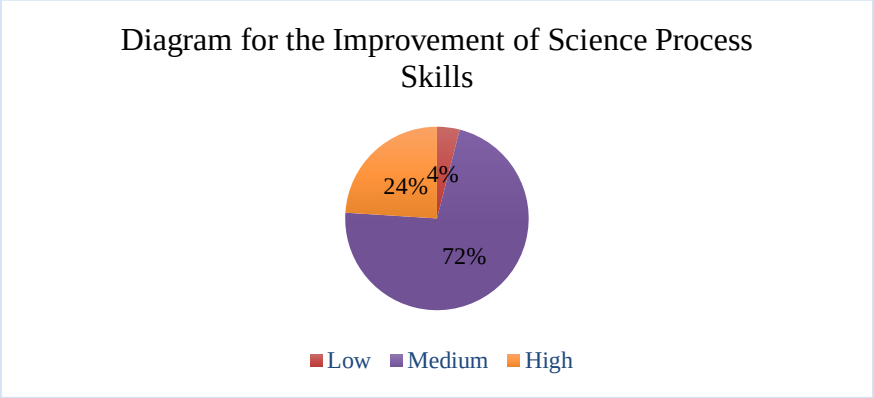


Figure 2. The percentage increase in Science Process Skills with N-Gain

The improvement of science process skills was calculated using the N-gain test analysis. Based on Table 4 and Figure 2, after implementing LKPD based on Project Based Learning on environmental pollution material by using the gain score calculation, 24% of students experienced an increase in science process skills with high criteria. As many as 72% of students experienced an increase in science process skills in the medium category, and as many as 4% of students experienced an increase in science process skills in the low category. Learning using LKPD based on Project Based Learning students go directly to the field and observe the surrounding environment, so that they can solve problems through a scientific investigation as a form of direct learning experience.

Increasing students' science process skills is also influenced by an increase in the average score of each indicator of science process skills. The results of improving science process skills for each aspect of skills can be seen in Table 5.

Table 5. Improvement of Each Aspect of Science Process Skills

| Aspects of Science Process Skills | Average | | <g> | Category |
|---|---|---|---|---|
| | Pretest | Posttest | | |
| Asking question | 61 | 81 | 0,5 | Medium |
| Formulating Hypotheses | 70 | 100 | 1,0 | High |
| Carry out Experiments | 54 | 73 | 0,4 | Medium |
| Applying Concepts | 90 | 98 | 0,8 | High |
| Communicate | 58 | 79 | 0,5 | Medium |

Based on Table 5. It is known that the science process skills being trained have resulted in an overall increase for each indicator. The average of the five indicators of science process skills is in the medium to high category. Based on Table 5, every aspect of the science process skills trained has increased. The skills of asking questions, conducting experiments, and communicating have increased in the range of 0.4 - 0.5 with medium categories. Meanwhile, the skills to formulate hypotheses and apply concepts are 0.8 and 1.0 in the high category.

Learning using LKPD based on Project Based Learning on environmental pollution material students are trained by directly observing the environment around them. According to Istiqomah et al. (2020), states that when students do

experiments, students will practice their skills and process abilities. So that scientific skills have an impact on overall achievement. Students are given the opportunity to express their personal experiences related to environmental pollution around them. (1) Skills to ask questions, students observe several photos and videos about environmental damage that occurs in the vicinity displayed by the teacher. Observing activities can provide more meaningful learning, because students observe the phenomena that exist in the surrounding environment. Rustaman et al (2014) observing activities are useful for fulfilling curiosity. So that an indicator of science process skills will appear in the form of asking questions.

In science process skills, (2) formulating hypotheses, students are expected to be able to make temporary guesses of the problems that occur in the environment. Students must make logical guesses and can be tested through experiments. Skills to formulate hypotheses have increased from a pretest mean of 70 to 100 after learning using Project Based Learning LKPD on environmental pollution material. The process of formulating this hypothesis has increased the gain score by 1.0 in the high category. Problem-solving ability is the most complex level of individual cognitive activity that requires efforts to solve problems that involve all parts of an individual's intellectual (Hobri et al., 2020). In the science process skills (3) conducting the experiment, it has increased with an N-Gain value of 0.4 in the medium category. The percentage of indicators for planning experiments is not high because students are not accustomed to planning their own experiments to carry out investigations with experimental steps that are already available in students' books or worksheets. This shows that planning activities for experiments still need to be trained on students so that students are trained in planning experiments by discussing with a group of friends.

In process skills (4) Applying the concept, this skill has increased with a high category with an N-Gain value of 0.8. The high value of the increase in applying the concept to learning using LKPD based on Project Based Learning on environmental pollution material, is because students do not only hear explanations from the teacher, but also experience the learning process themselves. In learning using LKPD PjBL students have the opportunity to find their own information and combine some of the facts they get and can solve problems that occur in the surrounding environment, so as to stimulate students' understanding of concepts. (Susilawati et al., 2015).

The next skill is (5) communicating. In this skill, students have increased with an N-Gain value of 0.5 in the medium category. The increased ability to communicate is also caused by the learning experience of the students themselves which are demanded by LKPD based on Project Based Learning. Students deliver the results of experiments through presentation activities to practice communication skills, because the activity of reading graphs, tables and diagrams of experimental data and explaining the process and results of experiments that have been carried out includes communicating (Rustaman, 2005). In line with the research results of Karamustafaogluh (2011), it is stated that science process skills will not develop in students when the learning process does not accommodate

scientific activities that can lead to scientific attitudes and hone skills in students. The results of research conducted by (Janbuala et al., 2013); (Safitri et al., 2020) stated that scientific learning can improve students' science process skills and increase environmental knowledge.

### *Hypothesis Test for Student's Science Process Skills*

Table 6. Test dependent t-test of Students' Science Process Skills

| Result | N | Df | Sig. | T-Count | T-Tabel |
|---|---|---|---|---|---|
| Preetest-Posttest | 25 | 24 | 0,000 | 10,681 | 2,06390 |

Table 6. shows that the value of t count> t table is 10.681> 2.06390. Based on the conclusion of the hypothesis, it shows that if t> t table, then H0 is rejected and H1 is accepted. This means that the Project Based Learning-based Student Worksheet (LKPD) developed has an effect on students' science process skills.

## 4. Conclusion

Based on the results of research on the development of LKPD based on Project Based Learning on environmental pollution material, the first conclusion is that the application of PjBL-based LKPD has an influence on students' science process skills, with a KPS score of 83.2 in the Good category. Second, based on the results of hypothesis testing the Student Worksheet (LKPD) based on Project Based Learning that was developed had an effect on students' science process skills.

## Acknowledgement

Thank you Dr. Suwondo, M.Si and Dr. Wan Sayafii, M.Si, who guided the research. This research was funded independently by researchers.

## References

Afdareza, M, Y., Yuanita, P., & Maimunah. (2020). Development of Learning Device Based on 21st Century Skill with Implementation of Problem Based Learning to Increase Critical Thinking Skill of Students on Polyhedron for Grade 8th Junior High School. *Journal of Educational Sciences*, *4(2)*, 273-284.

Arikunto, S. (2006). Metode *Penelitian Kualitatif*. Jakarta: Bumi Aksara.

Asan, A., & Haliloglu, Z. (2005). Implementing project based learning in computer classroom. *The Turkish Online Journal of Educational Technology*, *4(3)*, 68-81.

Bundu, P. (2006). *Penilaian Keterampilan Proses dan Sikap Ilmiah dalam Pembelajaran Sains di Sekolah Dasar*. Jakarta: Dirjen Dikti.

Departemen Pendidikan Nasional. (2003). *Undang-Undang Republik Indonesia Nomor 20 Tahun 2003 Tentang Sistem Pendidikan Nasional*. Jakarta.

Deta, A, U., Suparmi., & Widha, S. (2013). Pengaruh Metode Inkuiri Terbimbing dan Proyek, Kreativitas, Serta Keterampilan Proses Sains Terhadap Prestasi Belajar Siswa. *Jurnal Pendidikan Fisika Indonesia, 9(1)*, 28-34.

Dick, W., & Carey, L. (2005). *The Systematic Design of Instruction. ; 6th ed.* Allyn and Bacon.

Elaine, H.J.Y., & Goh, K. (2016). Problem-Based Learning: An Overview of its Process and Impact on Learning. *Journal of Health Professions Education, 2(2)*, 75-79.

Fikriyah, M., Indrawati., & Gani, A, A. (2015). Model Pembelajaran Berbasis Proyek (Project Based Learning) Disertai Media Audio-Visual Dalam Pembelajaran Fisika di SMAN 4 JEMBER. *Jurnal Pembelajaran Fisika FKIP Universitas Jember, 4(2),* 181–186.

Gafur, I, A., Yustina., & Zulfarina. (2020). Difficulties in the Material of Skeleton Systems and the Application of ICT in Learning Natural Sciences (IPA). *Journal of Educational Sciences, 4(1),* 187-199.

Hayati, N, M., Supardi, I, K., & Miswadi, S, S. (2013). Pengembangan Pembelajaran IPA SMK dengan Model Kontekstual Berbasis Proyek untuk Meningkatkan Hasil Belajar dan Keterampilan Proses Sains Siswa. *Jurnal Pendidikan IPA Indonesia, 2(1),* 53-58.

Hobri, Ummah, I. K., Yuliati, N., & Dafik. (2020). The Effect of Jumping Task Based on Creative Problem Solving on Students' Problem Solving Ability. *International Journal of Instruction,13(1),* 387-406.

Istiqomah., Suwondo., & L.N, Firdaus. (2020). Environmental Education in Forming Attitudes of Environmental Care for Students in Adiwiyata Middle School, Pekanbaru City. *Journal of Educational Sciences, 4(1),* 200-211.

Janbuala, S., Dhirapongse, S., Issaramanorose, N., & Iembua, M. (2013). *A Study of Using Instructional Media to Enhance Scientific Process Skill for Young Children in Child Development Centers in Northeastern Area. In International Forum of Teaching and Studies.* American Scholars Press, Inc.

Jeenthong, T., Ruenwongsa, P., & Sriwattanarothai, N. (2014). Promoting integrated science process skills through betta-live science laboratory. *Procedia Social and Behavioral Sciences, 116(1)*, 3292–3296.

Karamustafaoglu, S. (2011). Improving the Science Process Skills Ability of Science Student Teachers Using I Diagrams. *Eurasian J. Phys. Chem. Educ, 3(1),* 26-38.

Kharisma, A, D., Syafii, W., & Zulfarina. (2020). Design of Student Worksheets based on Augmented Reality. *Journal of Educational Sciences, 4(1),* 176-186.

Lucas, G. (2005). *Instructional modeule project based learning*. Educational Foundation.

Lufri., Laili, F., & Anhar, A. (2020). Effect of Active Learning in Form of Scientific Approach with Assistance of Student Worksheets Based Problem Based Learning (PBL) Towards Students' Biology Psychomotor

Competence in Bacterial Material. *Journal of Educational Sciences*, *4(1)*, 20-29.

Mitchell, S., Foulger, T, S., Wetzel, K., & Rathkey, C. (2009). The Negotiated project approach Project based Learning without leaving the standards behind. *Early Childhood Education journal*, *36(4)*, 339-346.

Munawaroh, A., Christijanti, W., & Supriyanto. (2013). Penerapan Model Pembelajaran Berbasis Proyek Untuk Meningkatkan Hasil Belajar Sistem Pencernaan SMP. *Unnes Journal of Biology Education*, *2(1)*, 92-98.

Ningsih, F., Murni, A. & Roza, Y. (2020). Development of Learning Tools with the Application of Learning Inventions to Improve Mathematical Problem Solving Ability Social Arithmetic Material. *Journal of Educational Sciences, 4(1)*, 44-52.

Nurohman, S. (2010). Pendekatan Project Based Learning Sebagai Upaya Internalisasi Scientific Method Bagi Mahapeserta Didik Calon Guru Fisika. *Jurnal FMIPA UNY.*

Paidi. (2011). Pengembangan Perangkat Pembelajaran Biologi Berbasis Masalah. *Jurnal Kependidikan, 4(2)*, 185-201.

Purwanto, N. (2002). *Psikologi Pendidikan. Bandung*: Remaja Rosdakarya.

Rose, R, A., & Prasetya, T, A. (2014). Keefektifan Strategi Project Based Learning Berbantuan Modul Pada Hasil Belajar Kimia Siswa. *Jurnal Inovasi Pendidikan Kimia, 8(2)*, 1360-1369.

Rustaman, Y., Nuryani. (2005). *Strategi Belajar Mengajar Biologi*. Malang: UN PRESS.

Safitri, W. I., Suryawati, E., & Yustina. (2020). Environmental Literacy Analysis of Junior High School Students in Pekanbaru City. *Journal of Educational Sciences, 4(1)*, 116-123.

Sudijono, A. (2008). *Pengantar Evaluasi Pendidikan*. Rajawali Press. Jakarta.

Sumarni, W. (2013). The Strengths and Weaknesses of theImplementation of Project Based Learning:A Review. *International Journal of Science and Research (IJSR) ISSN (Online)*, 2319-7064.

Susilawati., & Sridana, N. (2015). Pengaruh model pembelajaran inkuiri terbimbing terhadap keterampilan proses sains siswa. *Jurnal Tadris IPA Biologi, 3(1)*, 8-36.

Syafaren, A., Yustina., Mahadi, I., & Vebrianto, R. (2019). Increasing Critical Thinking Skills Through Natural Science Learning Based on the Integration of Guided Inquiry with Numbered Heads Together (NHT). *Journal of Educational Sciences*, *3(3)*, 433-444.

Yulis, P. A. R. (2018). Analisis Kadar Logam Merkuri (Hg) Dan (Ph) Air Sungai Kuantan Terdampak Penambangan Emas Tanpa Izin (Peti). *Jurnal Pendidikan Kimia, 1(2)*, 28-36.

How to cite this article:

Setiawan, R. R., Suwondo., & Syafii, W. (2021). Implementation of Project Based Learning Student Worksheets to improve Students' Science Process Skills on Environmental Pollution in High Schools. *Journal of Educational Sciences, 5(1)*, 130-140.