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Implementation of Project-Based Physics Learning to Improve Science Process Skills of 11th Grader at SMAN 1 Majene

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Abstract: Type of this research is a pre-experimental with One Group Pretest-Posttest research design. This research conducted to determine the improvement of students' science process skills after the implementation of project-based learning physics on static fluid material. The population of this study is all students of grade XI MIPA SMAN 1 Majene for the academic year 2021/2022 with the sample taken from class XI MIPA 1 with a total of 26 students. Science Process Skills of students are measured by using a test instrument. The results of this research indicate that there is an increase in the Science Process Skills of students on the observing indicator with an n-gain score is 0.56 and the planning experiment/project is 0.57 so that both were in the medium category. The indicator asking questions also increased with an n-gain score is 0.76 and the indicator applying concept is 0.84 so that both were in the high category. In general, the science process skills of students have increased with an n-gain score is 0.68 which is in the medium category.

Keywords: physics learning, project based learning, science process skills.

Abstrak: *Jenis penelitian ini adalah pra-eksperimen dengan desain penelitian One Group Pretest-Posttest. Penelitian ini bertujuan untuk mengetahui peningkatan keterampilan proses sains peserta didik setelah diimplementasikan pembelajaran fisika berbasis proyek pada materi fluida statis. Populasi dari penelitian ini adalah seluruh peserta didik kelas XI MIPA SMAN 1 Majene tahun ajaran 2021/2022 dengan sampel berasal dari kelas XI MIPA 1 dengan jumlah 26 orang peserta didik. Keterampilan Proses Sains peserta didik diukur menggunakan instrumen tes. Hasil penelitian ini menunjukkan bahwa terjadi peningkatan Keterampilan Proses Sains peserta didik pada indikator mengamati dengan nilai n-gain sebesar 0,56, indikator merencanakan percobaan/proyek sebesar 0,57 sehingga keduanya berada pada kategori sedang. Pada indikator mengajukan pertanyaan mengalami peningkatan dengan nilai n-gain sebesar 0,76 dan pada indikator menerapkan konsep sebesar 0,84 sehingga keduanya berada pada kategori tinggi. Secara umum, keterampilan proses sains peserta didik mengalami peningkatan dengan nilai n-gain sebesar 0,68 yang berada pada kategori sedang.*

Kata kunci: *pembelajaran fisika, pembelajaran berbasis proyek, keterampilan proses sains.*

▪ INTRODUCTION

Learning that is carried out by involving students to carry out an activity or learning by doing can make students get more experience by being actively involved when compared to students who only study the material (Hamalik, 2015), meaning that students who are active in the learning process by involving physical activities such as scientific work (scientific process) can gain more experience. Learning by doing is carried out to provide real experience to students in validating theories and concepts (Nantsou et al, 2020). According to Dale, students remember 90% of information through what they "say and do" (Chen et al, 2020). The implementation of the learning

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process in general expects students to gain the maximum possible knowledge, skills and experience.

Learning by doing can be carried out by students through scientific work/scientific processes. The scientific process is carried out to train students' motor skills through scientific activities, such as planning experiments/projects, conducting experiments/projects and so on. In line with physics subjects in secondary schools, that these subjects focus on providing direct experience to students to develop competencies and skills in order to be able to understand natural phenomena scientifically. In addition, physics lessons also direct students to "find out" and "act" so that they can be helped in getting a deeper understanding of natural phenomena. Experience related to natural phenomena can be obtained by students through scientific work.

The results of interviews with physics educators at SMAN 1 Majene obtained information that during the covid-19 pandemic the students at the school had never carried out scientific work activities/scientific processes so that their skill competencies, especially Science Process Skills (KPS) were not trained. Science Process Skills are needed by students to build knowledge (Aydin, 2013). According to Gultepe (2016) KPS is a tool that students can use to observe and understand natural phenomena around them. KPS students need to be trained so that they are able to develop the ability to acquire knowledge, concepts, and principles of physics through the skills they have (Sulastiani, Nurhayati, and Aslim, 2012).

Improving students' Science Process Skills can be done in various ways, one of which is by implementing Project-based Learning (PjBL) or Project-Based Learning. PjBL itself is a learning that can be used to develop competence in attitudes, knowledge and skills (Morales, Bang and Andre, 2012), this learning can also arouse students' interest and enthusiasm for learning (Albalushi and Aamri, 2014), and can improve problem solving abilities. for students (Chiang and Lee, 2016). PjBL can develop students' high-level cognitive skills such as data analysis, problem solving, decision making (Celik, Ertas and Ilhan, 2018). Nasir, Fakhrunnisa, and Nastiti (2019, p.235), stated that PjBL can improve KPS, creativity and collaboration of students. Meanwhile, Tias and Octaviani (2018, p.25) also provide research results that students who are taught with PjBL have better KPS than students who are taught using conventional learning.

21st Century Learning also supports the use of Project-Based Learning, because such learning can help students improve 21st century competencies and skills, namely collaborative, creative and innovative skills. Project-Based Learning asks students to make projects/products in groups (collaboratively) in creating/making products creatively and innovatively (Rahmini, Muris, and Amin, 2015). Responding to the descriptions above, the researchers examined a lesson that is expected to improve students' science process skills in physics learning, namely the use of project-based learning. This study aims to describe the science process skills of students before and after learning and to find out the improvement of students' science process skills after project-based physics learning is implemented.

▪ METHOD

The population in this study were all students of class XI SMAN 1 Majene, Mathematics and Natural Sciences Department, even semester of the academic year

2021/ 2022 as many as 4 classes with a total number of 150 students. The sample in this study came from the population with the number of sample groups as much as 1 class, namely class XI MIPA 1 which amounted to 39 students, but who participated in the whole learning as many as 26 people. The sample selection was carried out randomly without testing the clarity and stability of the sample group before being treated

. This type of research was a pre-experimental with One Group Pretest-Posttest design. Pre-experimental research is research conducted to determine the consequences of a treatment given by the researcher. The One Group Pretest-Posttest design is a research design that uses only one group that is randomly selected and given a test before (pretest) and after (posttest) treatment. In this study, researchers wanted to reveal the increase in students' Science Process Skills scores before and after being treated in the form of Project-Based Physics Learning. This research starts from the preparation stage, implementation (implementation of project-based learning) to data processing. Data collection was carried out for 1 month by implementing PjBL twice (two projects).

The instrument used is the PPP test instrument in the form of an essay with indicators of observing, asking questions, planning experiments and applying concepts. The instrument was tested through theoretical validity and empirical validity. Theoretical validity uses a content validity which is carried out through the agreement of the Gregory model expert with the agreement coefficient between experts obtained is 1.00. While the empirical validity is carried out by using the analysis of the product moment as a validity test, while the reliability test uses the Cronbach alpha through the SPSS version 25 program with a coefficient value of 0.64.

The data analysis technique used is descriptive analysis and n-gain test. Descriptive analysis was used to describe the Science Process Skills scores of students before and after treatment, the analysis was processed using the SPSS version 25 program and Microsoft Excel 2019 to calculate the average score, variance and standard deviation. The statistical categorization used in this study is the benchmark reference assessment (PAP) using the percentage score interval criteria. The following table provides a guideline for the categorization of descriptive statistical assessments:

Table 1. Guidelines for descriptive statistical assessment

Interval (%)	Criteria
$81\% < x \leq 100\%$	Very High
$61\% < x \leq 80\%$	High
$41\% < x \leq 60\%$	Middle
$21\% < x \leq 40\%$	Low
$0\% < x \leq 20\%$	Very Low

(Riduwan, 2018: 15)

The n-gain test (normalized gain) is a test carried out to determine the increase in the Science Process Skills score of students before and after being given treatment. The increase was taken from the difference in pretest and posttest obtained by students. After the n-gain value is obtained, the categorization of the increase can be done by referring to the normalized gain. The following table shows the normalized gain criteria:

Table 2. Guideline for N-gain score

Skor N-gain	Criteria
0.00 < N-gain < 0.30	Low
0.30 ≤ N-gain ≤ 0.70	Middle
N-gain > 0.70	High

(Kelly, Lesh dan Baek: 2014: 499)

▪ RESULT AND DISSCUSSION

Project-based learning is learner-centered learning (Kokotsaki, Menzies and Wiggins, 2016) which begins with students making a basic question related to the topic of the problem given by the teacher, then students design a possible project. can answer the basic questions that have been made previously. This research implements Project-Based Learning in Physics learning. There are several advantages of PjBL in physics learning, including: accommodating students' positive attitudes towards learning, fostering curiosity, stimulating learning enjoyment, guiding active and creative involvement in learning, encouraging collaborative independent learning, building personal and social relationships, and information and literacy literacy. technology (Santyasa, Rapi and Sara, 2020), besides that PjBL also leads students to understand science concepts in real life (Rosales and Sulaiman, 2016).

The implementation of project-based physics learning can improve Science Process Skills (Safaruddin et al., 2020) and is effective in developing students' creativity (Milla, Jufri and Soeprianto, 2019). PPP is needed to acquire and develop, apply concepts, legal principles and scientific theories. These skills can trigger discovery, development of facts and concepts, as well as the development of attitudes, insights and values for students (Toharuddin, Hendrawati and Rustaman, 2011). KPS is the ability to think and act that is used to discover, develop, and apply knowledge, which involves intellectual and psychomotor skills (Kustijono, Jatmiko, and Ibrahim, 2018). In this study, only the PPP indicator focuses on observing, asking questions, planning experiments and applying concepts.

The data in this study are the results of field studies obtained through the provision of Science Process Skills test instruments to students before and after treatment in the form of Project-Based Physics Learning.data pretest and posttest for the Science Process Skills of students in the material of Static Fluids for class XI MIPA SMAN 1 Majene for the academic year 2021/2022 were processed using the SPSS version 25 and Microsoft Excel 2019 program assistance. The following are the results of descriptive statistical analysis of the Science Process Skills scores of class XI students. MIPA SMAN 1 Majene before and after being given treatment in the form of Project-Based Learning is presented in Table 3 which is analyzed using the SPSS version 25 program below:

Tabel 3. Science process skills score

Statistics	Pretest	Posttest
Number of Samples	26	26
Ideal maximum score	32.00	32.00
Ideal minimum score	0.00	0.00

Maximum score	18.00	30.00
Minimum score	4.00	17.00
Average	9.68	24.77
Deviation standard	2.98	3.35
Variance	8.88	11.22

Table 3. provides general description of students' KPS scores before and after being treated. In general, the average KPS score of students before being treated was 9.68 or in the form of a percentage of 30% and was in the low category. While the average KPS score of students in general after being given treatment is 24.77 or in the form of a percentage of 77% and is in the high category. These data are in line with research conducted by Hernawati et al. (2018, p.2482) which states that PjBL has a significant effect on students' KPS. The following is a description of the students' science process skills before and after being given treatment, illustrated through a bar chart that was processed using the Microsoft Excel 2019 program with data derived from the percentage of pretest and posttest as shown below:

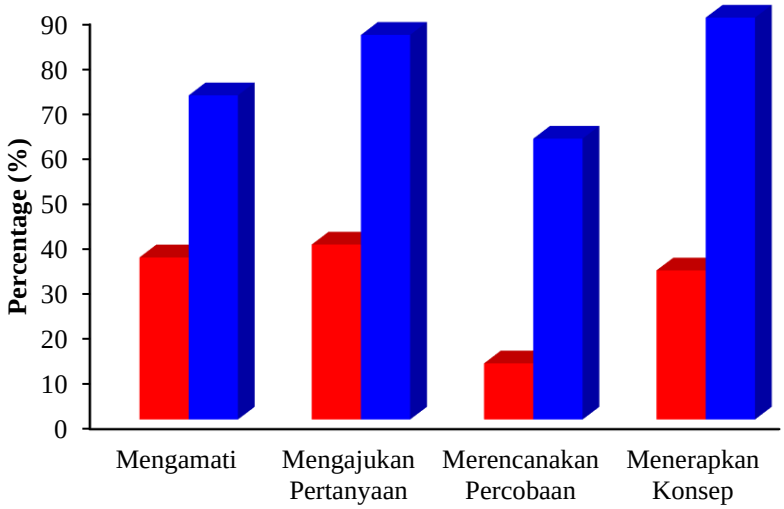

Figure 1. The average score for each observed indicators of science process skills in pretest (red) and posttest (blue)

Meanwhile, to find out the increase in students' Science Process Skills scores before and after given the treatment carried out the n-gain test (normalized gain). The results of the n-gain test for the KPS score of students on the indicator asking questions of 0.76 and the indicator applying the concept of 0.84 so that both are in the High category, while the observing indicator is 0.56 and the indicator planning an experiment is 0.57 so that both is in the Medium category. The n-gain value on the overall KPS score or in general in this study is 0.68 which means that the Science Process Skills score of students after being taught using Project-Based Physics Learning has increased in the Medium category. The following is an n-gain test chart for each indicator in the KPS score data analyzed using the Microsoft Excel 2019 program:

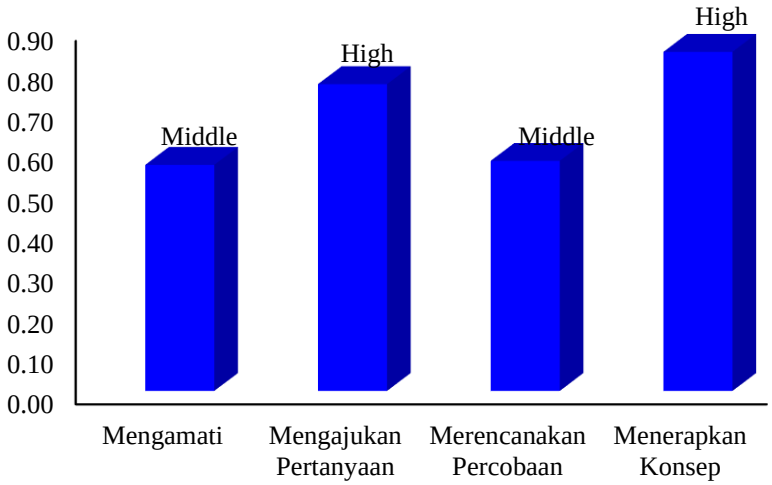

Figure 2. N-gain score for each observed indicators of science process skills

This research runs according to the project-based learning syntax, the first syntax of students is asked to observe videos and pictures and then ask questions that match the object being studied. observed. Observing is a basic skill that students must have in order to be able to find and receive information (Darmaji, Kurniawan, and Irdianti, 2019) in scientific work such as project-based learning. In this learning there are 6 syntaxes that must be done by students to complete a learning project. However, in PjBL observing skills are not trained directly but as a tool used in several syntaxes in PjBL such as the syntax for asking questions, the syntax requires students to observe problems in everyday life, at the step of compiling projects and testing results also requires observing skills. . Thus indirectly observing skills can be trained to students when using PjBL. Based on the results of data analysis, the n-gain value of 0.56 represents an increase in the KPS score of students on the observing indicator in the medium category. These results are in line with research conducted by Bhakti et al. (2020, p.3) that PjBL has an effect on increasing students' KPS in the aspect of Observing indicators.

Asking questions is a skill that requires students to think intelligently to make a question related to the object being observed. These skills can be trained to students through the use of project-based learning. This happens because in the project-based learning syntax there is a syntax for asking questions, precisely in the first syntax. The syntax forces students to make questions correctly. Thus, if PjBL is implemented, then educators can directly practice the skills of asking questions to students. Based on the results of data analysis in this study, it was found that the skills of asking questions of students who were taught using PjBL had increased with an n-gain value of 0.76 which represented an increase in the score of students in the High category. These results are in line with the research conducted by Setiawan, Suwondo and Syafii (2021, p.136) that students' questioning skills have increased after being taught with PjBL.

Planning Experiments is a complex activity in scientific work. These activities force students to determine the variables to be measured, design project designs, determine work procedures and so on. These skills can be trained through PjBL,

because in the PjBL steps there are activities that can practice experimental planning skills, namely the second syntax. The results of this study indicate that students' experimental planning skills have increased with an n-gain value of 0.57 which represents an increase in students' scores in the Medium category. These results are in line with research conducted by Roziqin, Lesmono and Bachtiar (2018, p.112) that PjBL has an effect on increasing students' KPS on the indicator of Planning an Experiment.

Applying concepts is the main skill trained in PjBL. This happens because in the implementation of the project students make project planning designs to find/understand the physics concepts that exist in the projects they are working on. So indirectly the whole series of steps in PjBL can train students to apply concept skills. The results of this study prove that PjBL can improve students' KPS on indicators of applying the concept with an n-gain value of 0.84 which represents an increase in students' scores in the high category. These results are in line with research conducted by Setiawan, Suwondo and Syafii (2021, p.137) that PjBL has an effect on increasing students' KPS on the indicators of Applying Concepts.

This study implemented PjBL twice (two projects). In the first project, students make a project about the application of the Law of Hydrostatics on a dam. In the second project, students make applications of Pascal's Law in everyday life such as hydraulic jacks. The two implementations gave the result that Project-Based Physics Learning succeeded in improving the Science Process Skills of class XI MIPA SMAN 1 Majene students on the indicators of Observing, Asking Questions, Planning Experiments, Selecting Tools and Materials, and Applying Concepts.

▪ CONCLUSION

Based on the results of the analysis and discussion in research on the Implementation of Project-Based Physics Learning to Improve Students' Science Process Skills in Class XI SMAN 1 Majene, conclusions can be drawn, the students' Science Process Skills scores before being taught using Project-Based Physics Learning in class XI of SMAN 1 Majene in the academic year 2021/2022 is 30% or is in the low category, while after being taught, the score becomes 77% or is in the high category, so that the increase in the average score of students is in the medium category with an n-gain value of 0.68.

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