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Skilled in Creating Power-Reducing Products for E-Size Guitar Strings (Star Missiles) through Project-Based Learning Models

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ABSTRACT

This research was conducted in mathematics and sciences class XII-2 high school 1 Sigaluh, on electromagnetic induction material. The data of this research are data improving science process skills and scientific attitudes. The research instruments are in the form of observation sheets for project implementation assessments and questionnaires. The results of the questionnaire show that 63% of respondents use electricity-saving lamps, 31% have not used electricity-saving lamps, and 6% choose to be absent. The results of observation on the star missile PjBL showed an average of 81 categories of the high predicate. The results of the science teacher's response questionnaire obtained a score with the predicate category that strongly agrees with the star missile project-based learning. While the results of the cognitive assessment of the Star Missile PjBL have an average of 85, project appraisal with an average of 83.8 for star missile product appraisal has an average score of 85.8. Based on the results, it can be concluded that the application of the star missile project-based learning model can improve science process skills and scientific attitudes and is expected to can provide input for Physics teachers in implementing the star missile project-based learning model on KD 4.5.

INTISARI

Penelitian ini dilaksanakan di Kelas XII SMAN 1 Sigaluh, Materi Induksi Elektromagnetik dengan subyek penelitian adalah Kelas XII mathemati 2. Data penelitian ini adalah data tentang peningkatan keterampilan proses sains dan sikap ilmiah. Instrumen penelitian berupa lembar pengamatan penilaian pelaksanaan proyek dan angket kuisioner. Hasil kuisioner tentang perilaku hemat energi listrik menunjukkan, 63% responden menggunakan lampu hemat listrik, 31% belum menggunakkan lampu hemat listrik, dan 6% peserta didik memilih absen. Hasil angket lembar observasi peserta didik dalam proses pembelajaran berbasis proyek rudal star dengan indikator pertanyaan empat soal menghasilkan rerata 81 kategori predikat tinggi. Hasil kuisioner tanggapan guru IPA tentang pembelajaran berbasis proyek rudal star memperoleh nilai dengan kategori predikat sangat setuju dengan pembelajaran berbasis proyek rudal star. Sedangkan hasil penilaian Kognitif tentang pembelajaran proyek rudal star memiliki rata-rata 85, penilaian proyek dengan rerata 83,8 untuk penilaian produk rudal star memiliki rata-rata nilai 85,8 dengan nilai (KKM) sekolah 65. Berdasarkan hasil analisis data dan pembahasan hasil penelitian, dapat disimpulkan bahwa penerapan model pembelajaran berbasis proyek rudal star dapat berkontribusi positif pada peningkatan keterampilan proses sains dan sikap ilmiah dan diharapkan dapat memberikan masukan bagi guru Fisika dalam menerapkan model pembelajaran berbasis proyek rudal star pada KD 4.5.

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A. Introduction

Physics is the study of natural phenomena or in other words, physics is an empirical science, because it is empirical, so observations and experiments are the main things. So that student are led to make direct contact with the object under study. With direct contact with objects, students carry out scientific products, scientific processes, and scientific attitudes. Today, there are still students who are apathetic toward physics subjects [1]. They justify that Physics subjects are complicated and difficult to understand so they are less able to explore existing learning resources. In addition, students lack a scientific attitude which affects the learning atmosphere, students feel uncomfortable, and lack interaction well, lack of cooperation, resulting in less effective communication, and less activity and creativity so that they do not develop thinking that learning objectives are not achieved,

teachers have not been precise in describing/analyzing basic competencies (KD) as indicators of competency achievement (GPA), as a result, the materials and learning activities designed are not in accordance with the expectations of the basic competencies (KD) [2]. In the odd semester of the mathematics and sciences class, XII-2 for the physics subject, such as in KI 4 skills in KD 4.5 is creating simple products using the principle of electromagnetic induction. The teacher rarely notices the assessment of skills at KD 4.5, the teacher has not been able to direct the students to what products will be created, and the time is not sufficient because the time is more concerned with preparation for the implementation of the School Examination (US), the teachers make a greater percentage of e right to perform cognitive assessments.

Teachers are less innovative in the application of models, methods, and learning approaches that are in accordance with the material to be delivered [3].Teachers do not apply the subject matter contextually in everyday life, so the message conveyed is not well received by the students. Teacher creativity about the development of learning media is less supportive so students are less active in learning activities. Teachers also do not understand the concept of 21st-century skills and strengthening character education (PPK) in application to the learning process so the assessment has not been authentic or comprehensive, both cognitive, psychomotor, and affective.

To encourage students' ability to produce contextual work, both individually and in groups, one of the Learning Implementation Plans (RPP) in the learning process uses the Project Based Learning (PjBL) model [4]. Encouraging by the PjBL, we proposed electronic media to fulfill the educational needs. This tool stabilizes the electromagnetic current when the electronic device is first turned on. This tool is called the Star Missile (Guitar String Electronic Power Reducer) which is made of E guitar strings (the smallest size) and is shaped like a solenoid coil (coil). The guitar strings are embedded into a 1.5-inch pipe using white cement. The two ends of the coil are connected to the socket, and the other is connected to the jack. This way, we expect the result to be close to being a ref Yuliani [5] and Kolai [6].

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B. Method

The method used in this research is a quantitative method of experimental explanation. This method is very effective for data collection in order to measure the effect or effectiveness of a tool, or media under certain conditions [7]. In this study, the implementation of the Star Missile project activity was the independent variable and the student's scientific attitude was the dependent variable. The data collection method used in this research is in the form of quantitative data. Data collection techniques using observations by filling out questionnaires. The population is students in the mathematics and sciences class XII-2 odd-semester on electromagnetic waves.

The instrument used to collect data on science process skills is based on the Star Missile project-based learning observation sheet in the form of an observation sheet project implementation assessment, the aspects assessed are planning, implementation, and project final report. The result of the assessment is in the form of a score that is worth a number which states the predicate is good, sufficient, or less. In the product assessment sheet, the aspects that are assessed are the planning of materials and tools, the manufacturing process, and product results, from the three aspects of the assessment it is reduced to nine question indicators. The assessment score is in the form of a numerical score that has a predicate. To find out the understanding of the process of making Star Missiles, students are provided with worksheets (LKPD). The instrument used to observe the scientific attitude of students in participating in the Star Missile project-based learning using a questionnaire in the form of learning implementation, motivation for the implementation of PjBL Missile Star, and Evaluation of project results reports, with an assessment score in the form of numbers stating strongly agree, agree, disagree and strongly disagree.

The data analysis used in this research includes observational analysis and questionnaire analysis. Each observation has a scoring grid and rubric. The observational analysis includes science process skills, project product assessment, and assessment format for project learning activities implementation. The questionnaire analysis includes a questionnaire on household consumer behavior towards energy-saving behavior, as well as a scientific attitude questionnaire on the Star Missile project-based learning. The analysis is carried out with the following steps:

1. Give a score at the time of assessment
2. Calculating the scores obtained by students with the observation sheet
3. Calculating the total score obtained by students
4. Calculating the ability of science process skills in Star Missile project-based learning with the formula:
   a. The ability of science process skills in project-based learning

$$N = \frac{X}{T}\ 100\% \qquad (1)$$

N : Number of Missile

X : The total value obtained

T : Total Score

b. Analysis of Scientific Attitude Questionnaire

The scientific attitude assessment is in the form of a rating scale observation sheet using a Likert scale accompanied by a rubric. Next, calculate the percentage of student response questionnaire scores using the formula (1). Analysis of the questionnaire data by scoring the answers on the answer choices with the following criteria:

Score 5	= Strongly agree	= Very high
Score 4	= Agree	= High
Score 3	= Disagree	= Moderate
Score 2	= Disagree	= Low
Score 1	= Strongly disagree	= Very Low

With the Observation scoring rubric on scientific attitudes and science process skills of students in participating in Star Missile project-based learning activities

Table 1. Questionnaire scoring rubric

Level of success	Predicate
86 – 100%	Very high
71 – 85 %	Tall
56 – 70%	Currently
41 – 55%	Low
< 40	Very low

The stages of this research activity are based on pre-programmed and systematic methods. There are four stages which are divided into several activities for each meeting. The following shows the method of solving the problem in tabular form.

Table 2. Method of implementation of PjBL Missile Star

Stages	Activity
1. The initial activity is to find out students' understanding of electrical material	Distributing household consumer behavior questionnaires about electricity-saving behavior
2. The use of Star Missile RPP by using Method: lecture, discussion, question, and answer, using PowerPoint media	1. Explanation of the basic concept of Star Missile 2. Doing Student Worksheets on Electromagnetic Induction Experiments 3. Random division of groups by distributing rolls bearing the name of the animal, by mentioning the sound of the animal while in groups (4-5 children per group) 4. Discuss with the Star Missile LKPD guide 5. Presenting the results of the Star Missile LKPD 6. Assessment during teaching and learning activities

Stages	Activity
3. The use of the Star Missile RPP using the Star Missile PJBL Model, methods, lectures, discussions, and experiments	1. Creating a project implementation grid 2. Technical explanation of the implementation of the Star Missile project 3. Project implementation for 2 – 3 weeks 4. Project activity assessment 5. Product Rating 6. Assessment of skills and attitudes on student observation sheets by teachers and collaborators 7. Upload videos to youtube 8. Writing the Star Missile Implementation Report
4. Questionnaire filling	1. Questionnaire of science teachers' responses to implementing PjBL Missile Star 2. Questionnaire of student responses about learning the Star Missile project

C. Results and Discussion

To encourage students' ability to produce contextual work, both individually and in groups based on the Star Missile Project as an alternative to completion in KD 4.5 Creating simple products using the principle of electromagnetic induction. Star missile tool making is very simple, utilizing existing used materials, materials, and tools are easy to obtain and do not take a long time in the manufacturing process. With the main ingredients of size E guitar strings, pipes, and white cement, it can be an alternative to overcome Electromagnetic blackouts (falls) if you turn on electronic devices simultaneously with unbalanced Electromagnetic power (lowering power on electronic devices). So the hope is that Star Missile project-based learning can improve cognitive abilities, and scientific attitudes and improve science process skills.

1. An initial understanding of the behavior of household consumers towards the behavior of saving electrical energy

The results of a questionnaire about the behavior of household consumers towards electrical energy-saving behavior in class XII MIPA students of High School 1 Sigaluh have a function to find out how deep the concept of alternating current (AC) electricity is in its application in everyday life, the results of the questionnaire on the behavior of household consumers towards the behavior of saving electrical energy also provide supplies and instill an attitude or cultivate a culture of saving electricity. The results of the questionnaire also provide a sample picture of students' attitudes about electricity-saving behavior in High School 1 Sigaluh. The number of respondents filling out a questionnaire about the behavior of household consumers towards the behavior of saving electrical energy is 35 students. The number of questions is 31 questions by choosing one of several answers. Consists of two parts of questions, the questions in the first part contain the identity of the respondent, the second part contains the behavior of saving electricity. The following will present

some of the results of the electricity-saving behavior questionnaire. Several other questionnaire results are explained in the appendix of this study.

Based on the results of a questionnaire analysis on an identity consisting of name, gender, class, address, age, class classification of home electricity customers, types of electronic equipment used, and the average number of monthly electricity payments on electricity consumer behavior towards electricity-saving lifestyles, some students of class XII-2 majoring in science with the number of respondents 35 students with the age of most 17 years 85 % of the total number.

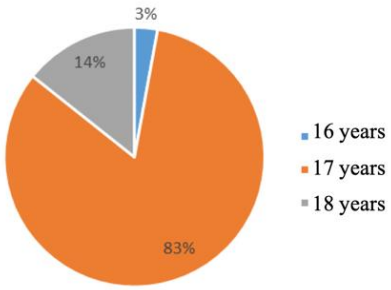

Figure 1 . Age of respondents for saving electricity

The results of the questionnaire on the class classification of home electricity customers on the respondents showed that 51% had a home power capacity of 450 Watts. The electric power capacity of 900 Watts shows a yield of 46% while the more 3% has a home power capacity of 1300 Watts.

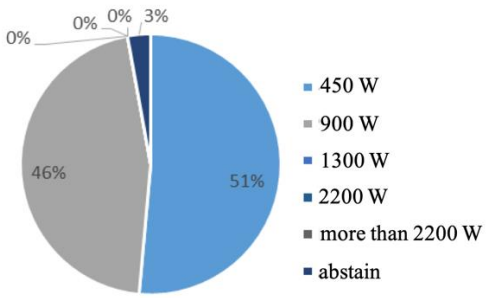

Figure 2. Class classification of respondents' home electricity customers

The results of the questionnaire regarding the class classification of the largest home electricity customer have an electric power capacity of 450 Watts, these results also show that the types of electronic equipment that are turned on are limited. This proves that the Star. The missile is needed in helping to simultaneously turn on several electronic devices.

Several electricity-saving measures based on the results of the questionnaire show that most of the students of mathematics and sciences class XII-2 High School 1 Sigaluh do not understand electricity-saving measures in the application of daily life.

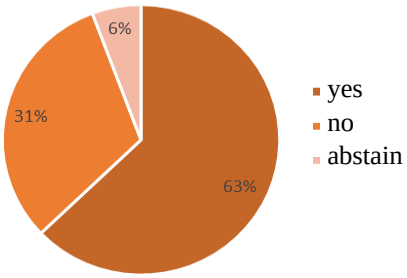

Figure 3. The respondent's use of electricity-saving lamps

The house lighting used by some respondents has not used electricity-saving lamps. Approximately 31% have not used electric energy-saving lamps. The percentage of respondents' reasons for not using electrical energy-saving lamps is that electric energy-saving lamps are expensive 31%, electrical energy-saving lamps are difficult to obtain 4%, there is no guarantee that electric energy-saving lamps will be more efficient 26%, the choice of other reasons is 35%, This shows that some respondents still do not understand some electrical energy-saving measures. The percentage of the reasons for choosing energy-saving lamps is illustrated in the figure 4 below.

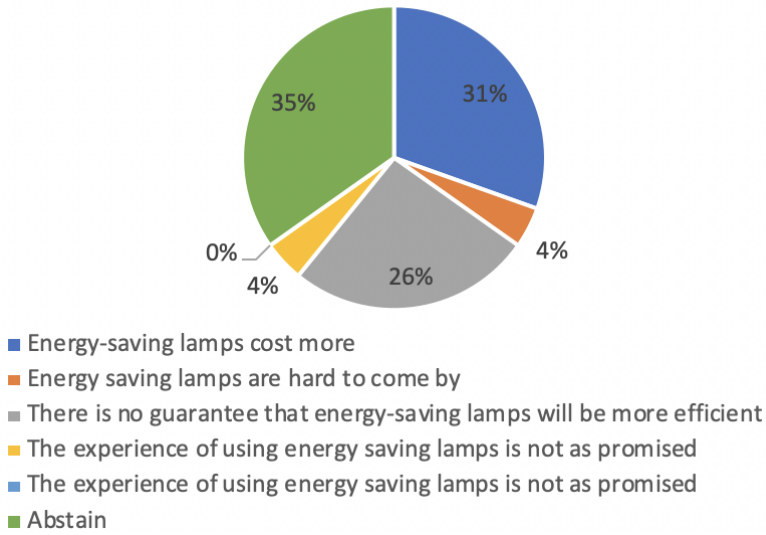

Figure 4 . Electric energy saving lamp response

About 60% of respondents chose the peak load time on their home network from 17.00 to 22.00 WIB.

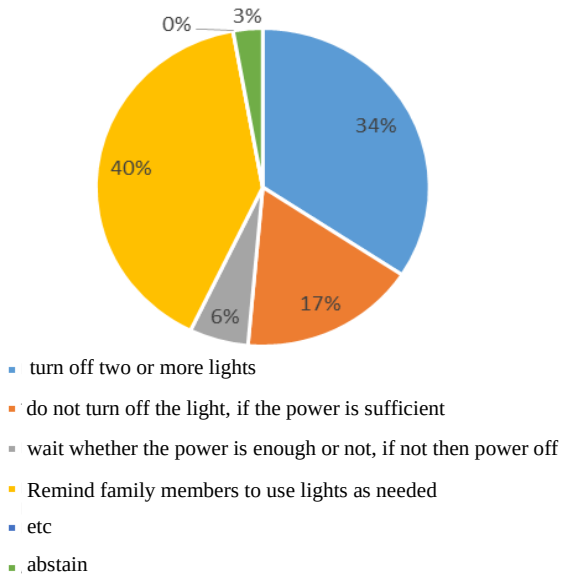

Figure 5. Energy saving measures

The reason for choosing the time was because at that time all the lighting was on, and most of all family members were at home with various activities related to the use of electrical energy. Approximately 40% of respondents choose the action of reminding family members to use lights according to their needs, respondents have not taken concrete actions based on their awareness to take action to save electricity. For this reason, it is necessary to provide a more contextual explanation of concepts for the application of electrical energy-saving materials in everyday life.

2. The results of the student's observation questionnaire regarding the scientific attitude of implementing the Star Missile Project-based learning implementation on the material of Mathematics and Sciences Class XII-2 in the odd-Semester Electromagnetic Induction by subject teachers and collaborators

This questionnaire aims to collect data about the scientific attitude of students in participating in learning activities based on the Star Missile project conducted by subject teachers and collaborators during the implementation of learning. There are nine (9) observations about the scientific attitude of students during the implementation of the Star Missile project-based learning. Subject teachers and collaborators are recommended to choose a score according to their own choice by placing a checklist (v) in the score column (5,4,3,2,1) according to the following criteria 5 very high, 4 high, 3 moderate, 2 low, 1 very low.

Questionnaire data processing on the scientific attitude of students in participating in Star Missile project-based learning activities refers to (Source: adaptation from Agip et al: 41) with the acquisition of a percentage range of values to

determine very high, high, medium, low, and very low predicates. The results obtained by twenty-five (25) students are shown in the following figure 6 :

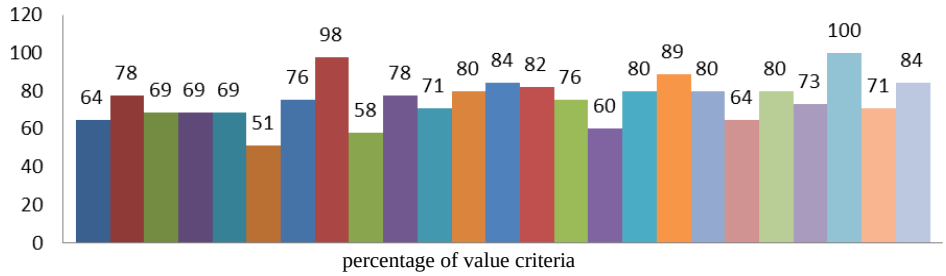

Figure 6. The results of the students' scientific attitude questionnaire scores

Based on the score acquisition table, the percentage of predicates is very high, high, and medium in the questionnaire regarding the scientific attitude of implementing Star Missile Project-based learning on the material of mathematic and sciences class XII-2 in the odd Semester High School 1 Sigaluh shown in the following figure 7:

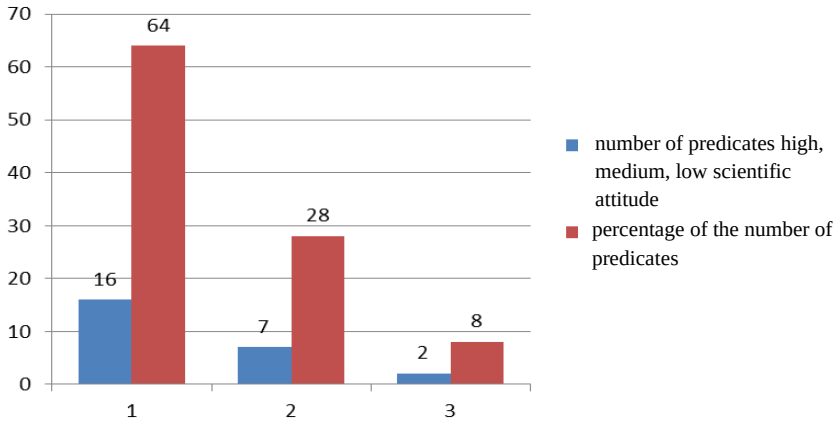

Figure 7. Results of the percentage of scientific attitude predicate

The number of respondents filling out the scientific attitude questionnaire was twenty-five (25) students. The data obtained in the number of very high predicate percentages were 16 students so the percentage showed 64%, seven (7) high predicates showed a 28% percentage, while the low predicate 2 students showed an 8% percentage.

The results of the descriptive analysis of the questionnaire regarding the scientific attitude of implementing learning based on the Star Missile Project on the material of Electromagnetic Induction Class XII MIPA Odd Semester High School 1 Sigaluh as many as 25 respondents who chose very high as many as 16 respondents in the implementation of the Star Missile Project-based learning. This fact shows that the Star Missile project-based learning is very appropriate and an alternative to one of the most appropriate learning models for analyzing KD 4.5 Creating simple products using the principle of electromagnetic induction to improve students' scientific attitudes. Students are more enthusiastic when learning, students attention to teachers when delivering material, activeness in asking about students' skills in opinion or

criticism, interact in conducting discussions, order when following the learning process, the appearance of work results, and work on worksheets/ evaluation of learning outcomes become indicator measure of the achievement of the scientific attitude of students

3. The results of the student observation sheet questionnaire in the Star Missile Project-based learning process on the material of Class XII MIPA Odd Semester Electromagnetic Induction

To strengthen the results of the student's observation sheet data about the Star Missile project-based learning by the collaborators above, we also measured student responses questionnaires regarding the Star Missile Project-based learning. There are three indicators in the questionnaire regarding the implementation of the Star Missile Project-based learning on Electromagnetic Induction material, namely 1) regarding the implementation of learning described in eight (8) questions, 2) motivation for implementing the Star Missile project learning described in four (4) questions. , 3) evaluation of the project report described in three (3) questions, so that the total number of questions is fourteen (14) questions.

Students are encouraged to choose a score that is in accordance with their own choice by marking a checklist (v) in the score column (5,4,3,2,1) according to the following criteria 5 very high, 4 high, 3 moderate, 2 low, 1 very low. With the Observation scoring rubric on the scientific attitude of students in participating in Star Missile project-based learning activities.

Based on the results of the questionnaire data on student responses about the Star Missile project-based learning process based on the assessment rubric, the results are shown in the figure 8 below:

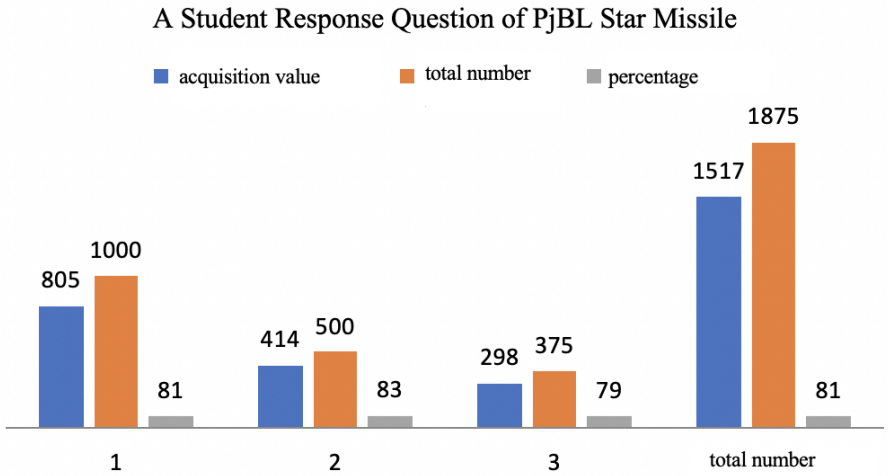

Figure 8. Student responses about PjBL Missile Star

The results of each indicator are presented in the graph above, the first indicator, namely the implementation of learning, shows the respondent's acquisition value with a total of 805, with a total of eight (8) questions descriptions with a maximum score

of five so that the total number of questions is worth 1000. By comparing the short score with the total number of questions. the average score of the indicator multiplied by 100% produces a score of 81, based on the rubric of assessment with a value of 81 indicating a high predicate. The second indicator, namely the motivation for PjBL Missile Stars, shows a total score of 414 respondents, with a total of four (4) question descriptions with a maximum score of five so the total number of questions is worth 500. Comparing the short-lived score with the total number of indicator scores multiplied by 100 % resulted in a score of 81, based on the rubric of assessment with a value of 83 indicating a high predicate. The third indicator, namely the motivation for PjBL Missile Stars, shows a total score of 298 respondents, with a total of three (3) question descriptions with a maximum score of five so the total number of questions is worth 375. Comparing the short-lived score with the total number of indicator scores multiplied by 100 % resulted in a score of 81, based on the rubric of assessment with a value of 81 indicating a high predicate. While the total average of the three indicators produces a percentage value of 81 with a high predicate.

The results of the student response questionnaire calculation data above further strengthen the results of the collaborator's questionnaire data on the Star Missile project-based learning process. The results of both data analyses showed high predicate. This shows that the Star Missile project-based learning model is very appropriate as a learning model in KD 4.5 Creating simple products using the principle of electromagnetic induction to improve students' scientific attitudes.

4. Questionnaire analysis of science teachers' responses to the process of PjBL Missile Star High School 1 Sigaluh

The missile star project-based learning is in practice assisted by science teacher collaborators. The role of peer teachers, especially science teachers, plays an important role in research, not only as collaborators but also as assessors of activities through a questionnaire on the implementation of Missile Star project-based learning activities. There are five (5) science teachers in High School 1 Sigaluh, one physics teacher, two biology teachers, and two chemistry teachers. The science teacher of High School 1 Sigaluh assessed the implementation of the Star Missile project-based learning by filling out a questionnaire. The teacher's response questionnaire on the implementation of Star Missile project-based learning has three indicators, namely 1) the implementation of PjBL Missile Starter contains eight statements, 2) Motivation towards the implementation of PjBL has two statements, 3) Evaluation of the project results report has two statements. The science teacher filled out the questionnaire by putting a checkmark in the score column (5,4,3,2,1) with the following criteria 5 strongly agree, 4 agree, 3 disagree, 2, disagree, and 1 strongly disagree. The results of the teacher's questionnaire on the implementation of the Star Missile project-based learning are shown in the following table 3:

Table 3. Table of responses from science teachers regarding the Star Missile PJBL

Indicator	Statement	Score	Percentage	Category	Rubric
Implementation of Star Missile PjBL	8	35	87	Strongly agree	30 – 40 = strongly agree, 19 – 29 = agree 8 – 18 = disagree
Motivation towards the implementation of Star Missile PjBL	2	10	100	Strongly agree	8 – 10 = strongly agree 5 – 7 = agree 2 – 4 = disagree
Project result report evaluation	2	9.5	95	Strongly agree	8 – 10 = strongly agree 5 – 7 = agree 2 – 4 = disagree

The results of the data on the teacher's response questionnaire about the Star Missile project-based learning above as a whole is illustrated in the following Table 4:

Table 4. The results of the science teacher questionnaire responses

Name	Score	Percentage
Teacher 1	49	82
Teacher 2	57	95
Teacher 3	55	92
Teacher 4	56	93

The results of filling in the teacher's response questionnaire regarding the implementation of Star Missile project-based learning show the results strongly agree on the three indicators. This shows that the Star. Missile project-based learning model very appropriate for KD 4.5 Creating simple products using the principle of electromagnetic induction to improve students' scientific attitudes.

5. Star Missile Science Process Skill Assessment

The Star Missile project-based learning process aims to measure students' scientific attitude as well as assess the science process skills of Star Missile project-based learning in accordance with KD 4.5 Creating simple products using the principle of electromagnetic induction. The assessment of the science process skills of Star Missiles is in the form of project learning assessments, project product assessments, and cognitive assessments of the concept of making Star missiles through Student Worksheets (LKPD). Project learning assessment and project product assessment are in the form of an assessment format that has a score by ticking and has an assessment rubric with a certain range. The three results of the Star Missile project-based learning science process skills assessment are as follows:

Table 4. Results of the Star Missile Science Process Skill Assessment

Group	Cognitive Value 1 (LKPD)	Cognitive Value 2 (LKPD)	Project Appraisal	Project Product Appraisal
1	87	86	91.6	84
2	85	76	86.1	90.6
3	89	89	80.5	87.5
4	84	84	77	81

The results of the assessment of the science process skills of the Star Missile project have met the Teaching Completeness Criteria (KKM) for Physics subjects at KD 4.5, namely 65. These results indicate that the Star Missile project-based learning activities make a positive contribution to improving science process skills and scientific attitudes in KD 4.5 Creating a simple product using the principle of electromagnetic induction.

D. Conclusion

Based on the results of the analysis and discussion of the implementation of the Star Missile project-based learning, it can be concluded that the use of the Star Missile project-based learning model as an alternative is more appropriate for use in KD 4.5 Creating simple products using the principle of electromagnetic induction. Based on the assessment of subject teachers and collaborators on the results of observations through filling out questionnaires, it shows that 64% of students are enthusiastic about participating in Star Missile project-based learning. The use of the Star Missile-based learning model can improve science process skills, and scientific attitudes and increase student achievement. This is reinforced by the results of the questionnaire analysis of student responses about the Star Missile-based learning process showing a score of 81% with a high predicate. The cognitive assessment shown from the results of working on the worksheets (LKPD), product assessments, and project results report assessments showed scores that exceeded the school's minimum completeness criteria. The use of the Missile Star project-based learning model can improve student achievement, science skills, and scientific attitude. Considering that the application of the Missile Star project-based learning model can improve scientific attitudes and science process skills in Physics subjects, teachers need to apply them in the learning process at school by innovating more on the size of guitar strings.

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Pendekatan Keterampilan Proses dengan Metode Eksperimen dan Demonstrasi Ditinjau dari Sikap Ilmiah dan Kemampuan Analisis (Studi pada Materi Pembelajaran Fluida Statis untuk Siswa Kelas XI Semester 2 SMA Negeri 1 Jakenan Pati T) (Doctoral dissertation, UNS (Sebelas Maret University), 2012.

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