

Development of Student Worksheets Based on Investigative Science Learning Environment (ISLE) Approach to Improve Students' Creative Thinking Skills

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Abstract: The aim of the research is to develop worksheets based on the ISLE approach to improve students' creative thinking skills. The method used in this research is research and development (R&D) and refers to the ADDIE development model. The student worksheets implementation design uses One Group Pretest-Posttest Design. The instruments used in this study were student worksheets assessment sheets, creative thinking skills test questions, student response questionnaires and teacher response questionnaires. Students' creative thinking skills were analyzed using the N-Gain test to see the improvement before and after the ISLE approach-based student worksheets was implemented. The results of the feasibility test in terms of the feasibility aspects of content, presentation and language obtained a percentage of 82, 88% indicated that the ISLE approach-based worksheets to improve creative thinking skills were very feasible to use. The results of the implementation of student worksheets based on the ISLE approach can improve students' creative thinking skills based on the N-Gain score in the high category. Teachers and students gave a very positive response to the ISLE-based student worksheets approach. The student worksheets based on the ISLE approach that has been developed statistically is feasible to use to improve students' creative thinking skills.

Keywords: Development of Student Worksheets; ISLE Approach; Students' creative thinking skills

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Introduction

In accordance with the 2013 curriculum, students are expected to be more active in applying several thinking skills, these skills include critical thinking skills, creative and innovative thinking skills (Detagory, et al, 2017). In this 21st century, every individual needs to prepare himself as a human resource who has a number of skills, such as being able to work together, think high-level, creative, skilled, understand various cultures and their potential, communicate effectively,

and be able to become a lifelong learner (Pusfasari, 2016).

In the learning process students need to have creativity in thinking that must be developed, because through creativity thinking students are able to develop and find ideas or ideas related to views and concepts and emphasize on aspects of thinking rationally. The ability to think creatively is very important in learning activities to improve the ability of higher mindset in solving problems in physics learning (Armandita dkk, 2017).

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The learning of physics is a part of the science that scientifically requires the concept of thinking and understanding that is integrated into the development of thinking analytical skills and systems. Tyaningsih, et al (2020) explained that creative thinking skills in Indonesia are still quite low, this fact is confirmed from the results of The Global Creativity Index in 2019, Indonesia is ranked 85 out of 129 countries. The low competence of students' creative thinking, caused by the inactivity of students in the learning process, because students only hear and record explanations given by teachers. Students are so rarely involved in the process of practicum activities in the classroom that students have not been trained to develop their creative thinking skills to discover physical concepts independently (Amaliah et al, 2019). Students have not been able to think systematically, have not been flexible in solving problems so that their creative thinking skills are still relatively low (Nurmalia et al, 2020).

Physics learning in Indonesia today focuses more on how to help students in increasing cognitive knowledge, but does not help students to learn how to apply scientific concepts that have been learned into real life outside of school (Koedinger et al. 2012). A similar opinion was also expressed by Pufasari (2016) who stated that in the process of learning physics in schools, teachers have not implemented efforts to empower students' thinking skills. Physics learning that should focus on science process skills will help shape creative thinking skills in learning physics which will eventually increase the activeness and creativity of students as well as students' academic competencies and achievements in physics learning.

Students' creative thinking skills can be grown and designed through learning based on the ISLE approach as stated by Rahmayani (2018) that ISLE is a model that encourages students to be active, creative and innovative in making observations and conducting experimental projects that can solve real problems involving groups collaboratively. In the ISLE approach, students are directed to understand concepts, to problem-solving skills, and most importantly so that they can use a variety of scientific abilities (Etkina, 2015).

In the learning process, teachers only act as facilitators who carry out a very important role in improving the quality of learning in the classroom. As a facilitator, teachers are expected to be able to create a learning resource that can support the achievement of learning goals. One form of learning resources that become an important part in supporting the learning process is teaching materials in the form of student worksheets. The student worksheets is a worksheet that contains guidelines for learners to carry out activities that reflect process skills so that learners acquire the

knowledge and skills that need to be mastered (Firdaus & Wilujeng, 2018).

Creative thinking skills can be trained one of them through the provision of direct experience to learners by giving work orders in the form of sheets contained in the student worksheets, this is in accordance with the results of research conducted by Pufasari (2016) which found that learning using student worksheets can help teachers in directing students to be able to find concepts and apply concepts creatively through their own activities or in work groups. Research on the ISLE approach has previously been conducted by several researchers, such as research conducted by Rahmayani (2018) which found that assessment of students' skills after applying the ISLE approach in class showed positive and promising results.

Pufasari (2016) states that learning using student worksheets can help teachers in directing students to discover and apply concepts creatively. Fithriyah (2018) research found that problem-based student worksheets can improve students' creative thinking skills and learning outcomes. Inquiry-based learning is able to increase the creativity of thinking skills (Sandika & Herlina, 2018). The effectiveness of student worksheets on students' creative thinking skills can increase with the fulfillment of indicators of students' creative thinking skills (Mukti et al, 2018). An important component of the ISLE approach is experimental design that occurs primarily in the laboratory, students can produce scientific evidence and explanations at the time of conducting experimental investigations in the laboratory (Etkina et al., 2011). ISLE directs students to be more active in investigative without detailed instructions. The investigations conducted in the ISLE approach are more about building knowledge (Irwandi, et al, 2020). Research on the development of ISLE-based learning devices has also been conducted by Ulfa, et al (2021) who found that ISLE-based learning devices can improve students' critical thinking skills, as well as critical thinking skills with interconnected creative skills in producing an effective thinking to solve a problem (Mayarni & Yulianti, 2020).

Based on the results of initial observations that have been made at State High School 9 Takengon Central Aceh Regency obtained that the process of learning physics is still done conventionally and centered on teachers. Based on the results of the student grade documentation study, it was found that only 42% of all students whose grades met the minimum completion criteria that had been set. In addition, in the process of physics learning, teachers have never used the ISLE-based student worksheets approach to improve students' creative thinking skills.

The student worksheets used by teachers, especially in simple harmonic motion material is an student worksheets that contains a collection of problem exercises to be done by students, not student worksheets which contains work steps to conduct an experiment, so that students' creative thinking skills are still low because students are not actively involved in the learning process that trains their thinking skills.

Based on the description above, the researchers conducted a study entitled student worksheets development based on the ISLE approach to improve students' creative thinking skills. The aim in this research is to develop a student worksheets based on the ISLE approach to enhance students' creative thinking skills.

Method

The method used in this study is Research &D. The student worksheets implementation design used is One Group Pretest-Posttest design. The development research model used in this research refers to the ADDIE development model.

This research was conducted at State High School 9 Takengon Central Aceh Regency with the subject of student worksheets implementation, namely the class X IPA1 students, totaling 25 students. The instruments used in this study were the student worksheets feasibility assessment sheet, essay test questions related to simple harmonic motion material to measure creative thinking skills, teacher response questionnaires and student response questionnaires to determine student and teacher responses related to the ISLE approach-based student worksheets that were developed.

The data from the pretest-posttest results of students' creative thinking skills were analyzed using the N-Gain test to determine the improvement obtained by students, then the normality of the data obtained was tested using the Shapiro Wilk statistical test.

Result and Discussion

Table 1. Results of Student Worksheets Feasibility Test Analysis

No	Eligibility Aspect	Percentage Value (%)	Criteria
1	Presentation	82.5	Very Eligibility
2	Contents	83.65	Very Eligibility
3	Language and Writing	82.5	Very Eligibility
4	Average value	82.88	Very Eligibility

Table 1 shows the average percentage rating of all aspects obtained is 82.88%. This shows that the student worksheets products made belong to the very

feasible category. After going through a validation process by an expert consisting of two expert lecturers as validators and the results obtained are very feasible, then the ISLE approach-based student worksheets is tested on students of class XI IPA 1 in State High School 9 Takengon Central Aceh Regency. The assessment of the test class students on the ISLE-based student worksheets was seen through the response questionnaires given to students. Student responses to student worksheets based on the ISLE approach showed a very positive attitude, this was shown based on the results of the questionnaire analysis of student responses in the test class which showed the number 90.52 and was in the very positive attitude category.

At the implementation stage (implementation) student worksheets based on the ISLE approach was applied to students of class X IPA1 at State High School 9 Takengon Central Aceh Regency which aims to see whether there is an increase in creative thinking skills after the student worksheets based on the ISLE approach is applied. This stage begins with the implementation process in the form of giving pretest questions for creative thinking skills to determine the initial creative thinking skills of each student on simple harmonic motion material, and at the end of the learning process a posttest is given to determine whether students' creative thinking skills increase or vice versa.

Based on the data analysis that has been carried out, the results show that there is an increase in students' creative thinking skills in terms of before and after the ISLE approach-based student worksheets is applied. The pretest-posttest data obtained was analyzed using the n-gain test to determine the categories of creative thinking skills improvements that students acquired. The results of the average values obtained can be seen in Table 2.

Table 2. Analysis of Improving Students' Creative Thinking Skills

Average Value		Normality*		N-Gain	Category
Pretest	Posttest	Pretest	Posttest		
33.23	82.80	0.777	0.395	0.75	High

In Table 2, the acquisition value of *pretest* students' creative thinking skills before the ISLE approach-based student worksheets was applied showed 33.23, this indicates that students' knowledge of simple harmonic motion material is still low. The posttest is given at the end of the lesson to see the improvement of students' creative thinking skills after the ISLE approach-based student worksheets is applied. Posttest results obtained an average percentage of 82.80. This is indicated by the increase in

the n-gain test score which shows the number 0.75 in the high category. Obtaining these scores shows a significant increase obtained by students after the ISLE approach-based student worksheets is applied. This increase can occur because by using the student worksheets based on the ISLE approach, students can easily understand the material they are learning and during the learning process, students can be actively involved so that they can develop their thinking skills through the activity steps that exist in the student worksheets based on the ISLE approach. As the results of research conducted by Rahmayani (2018) found that the student worksheets with the ISLE approach helps and makes it easier for students to understand the material in an interesting way.

Meanwhile, if it is reviewed based on indicators, the difference in the value of pretest and the posttest of students' creative thinking skills can be seen in Figure 1.

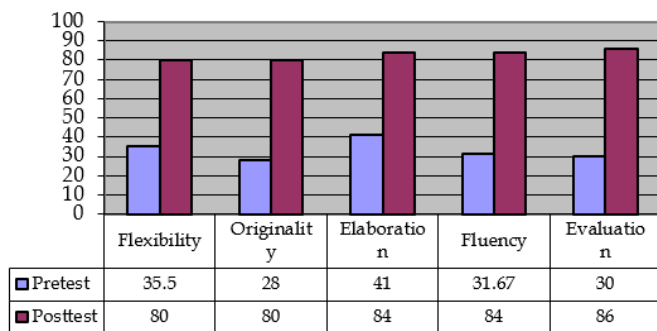


Figure 1. Comparison of Pretest-Posttest Scores of Creative Thinking Skills Based on Indicators

Based on Figure 1, it can be seen that the indicator flexibility, the pretest value produced is 35.5 with a posttest score of 80, while the originality indicator obtained a pretest value of 28 with a posttest value of 80, as for the elaboration indicator the resulting pretest value was 41 with a posttest value of 84, on the fluency indicator The resulting pretest value is 31.67 with a posttest value of 84 and the evaluation indicator obtained a pretest result of 30 with a posttest value of 86. This shows that the posttest value of students' creative thinking skills on each indicator is higher than the resulting pretest score. This proves that the implementation of the ISLE approach-based worksheets that have been developed is very effective in improving students' creative thinking skills.

Difference in value pretest and the posttest of students' creative thinking skills was caused by students' enthusiasm for learning when the ISLE-based student worksheets was applied. The student worksheets which contains steps to conduct experiments directly in accordance with the syntax of the ISLE approach makes students more enthusiastic in carrying out the learning process. Based on the results

of research conducted by Widodo, et al (2019) found that real practical learning can improve all aspects of creative thinking skills. Direct practicum learning provides better conditions for the development of students' creative thinking skills. Students tend to be more active if they have high creativity than their friends who have low creativity.

When learning activities take place, students explore everything they get during the experimental process in order to understand simple harmonic motion material easily based on the concepts they find in experimental activities, so that their creative thinking skills will also increase. This is in accordance with the statement given by Irwandi, et al (2020) that the ISLE method can be used to improve students' creative thinking skills through experiments conducted to build and develop concepts in physics learning so as to improve the learning outcomes obtained by students. This statement is in accordance with the results of research conducted by Hasrati (2021) which states that 78% of students state that experiments are effective for learning a concept.

The improvement of students' creative thinking skills on each indicator was also analyzed using the N-Gain test. The details of increasing students' creative thinking skills on each indicator based on the N-Gain test scores can be seen in Figure 2 below:

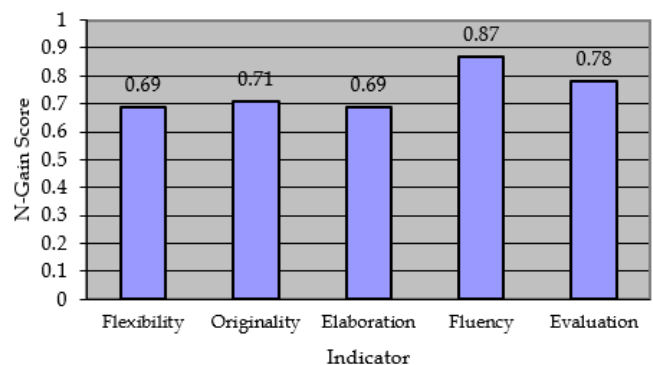


Figure 2. Average N-Gain Score on Each Indicator of Creative Thinking Skills

Based on the analysis of the n-gain test, there was an increase in creative thinking skills on the indicator flexibility, originality, elaboration, fluency, and evaluation. It can be seen in Figure 2 above that the highest increase occurred in the fluency indicator, namely fluent thinking skills. Fluency is assessed based on the ability of students to generate logical ideas and implies understanding, not just remembering what has been learned (Irfana, 2019). Efforts to improve creative thinking skills using student worksheets based on the ISLE approach in this study were able to develop fluency indicators. This is supported by the average value of the pretest-posttest which has increased by

0.75 with high criteria. In accordance with the research results of Ulfa, et al (2021) that ISLE-based learning is very suitable for improving 21st century skills including students' creative thinking skills.

Evaluation stage (evaluation) is the final stage of the development research carried out, at this stage the authors analyze the results of the response questionnaires given to teachers and students to provide an assessment of the ISLE approach-based worksheets that were developed. Based on the results of the response questionnaire analysis that has been carried out, students give a very positive attitude towards the ISLE approach-based worksheets on simple harmonic motion material. This is indicated by the score of the student response questionnaire which shows the number 84.85 and is in the very positive category. In addition to students, physics subject teachers also gave a very positive attitude towards the ISLE based on the student worksheets that had been developed. This was obtained based on the results of the questionnaire response analysis given to the teacher and showed the number 82.95 so that it was included in the category of very positive attitude.

Irwandi et al, 2020 said that the ISLE approach directs students to be more active in conducting investigations through experimental activities without detailed instructions to find a concept independently, so that it can help students understand the material more easily by being directly involved in the discovery of the concept and helping students to be able to develop skills that must be possessed in the 21st century. As Makhrus et al., 2018 stated that most teachers do not understand how to bring up 21st century skills in the preparation of student worksheets, so that student worksheets is impressed only for practicums that contain data or numbers from the results of the practicum. In addition, the student worksheets developed is also not in accordance with the model or teaching method used to fulfill 21st century skills.

The development of student worksheets based on the ISLE approach is very suitable for use in learning. Many abilities can be improved through student worksheets. The development of student worksheets in physics learning is an effort made so that students have attractiveness and increase student motivation in learning physics. Increasing student motivation is expected to provide an effective atmosphere in the teaching and learning process (Hasja et al, 2020). The student worksheets development has also been carried out in various other ways, including using PhET Simulation (Arifullah, et al., 2020), virtual Lab. PhET (Halim et al., 2021a), scientific approach (Halim et al., 2021b), and guided inquiry (Afrida et al., 2015)

Conclusion

Based on the results of the research that has been done, it can be concluded that the student worksheets based on the ISLE approach that was developed obtained very feasible criteria based on the feasibility test that had been carried out with a percentage of 82.88%. The student worksheets Based on the ISLE approach can improve students' creative thinking skills as indicated by the average N-Gain value on each indicator of creative thinking skills which shows 0.75 and is in the high category.

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