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International Journal of Educational Dynamics
Vol. 2 No. 2 (pp. 66-72) June 2020
p_ISSN 2655-4852
e_ISSN 2655-5093

THE DEVELOPMENT OF RESEARCH-BASED LEARNING DEVICES TO ENHANCE GRADE X STUDENTS' CRITICAL THINKING SKILLS IN LEARNING PHYSICS

Ajeng Suci Misndari [1)], R. Wulan [2)], Usmeldi [2)]

[1)] Post Graduate Program of Universitas Negeri Padang (Student), Indonesia
[2)] Post Graduate Program of Universitas Negeri Padang, Indonesia

Abstract

Physics learning in schools had not fully trained students' critical thinking skills. The reason was that learning has not been centered on students, and the learning devices used by teachers had not encouraged the active involvement of students in learning and finding their knowledge. Learning model that present a learning environment by emphasizing the central role of students is research-based learning. This learning model guides students to form hypotheses, collect and process data, and draw conclusions by discussing in groups. The involvement and activeness of students will encourage students' critical thinking activities. The aim of this study is the development of research-based learning devices with practical, valid, and effective criteria to improve students' critical skills on impulse and momentum material. The development model used is ADDIE from Branch. Research data was validity data, practicality data, and effectiveness data. The research instruments used were validation sheets, practicality sheets, and effectiveness sheets. This study had an output to create research-based learning devices with valid, effective, and very practical categories to enhance students' critical thinking skills.

Key word : research based learning, critical thinking skills

1. INTRODUCTION

The teacher as a facilitator in the learning process must develop a plan or learning tools. The combination of various learning activities will affect the level of achievement of students' competencies. Therefore, the planning and selection of appropriate learning tools are needed so that all components of the device support the learning process expected following learning objectives, facilitating students to gain learning experience and develop their potential to the fullest. Learning tools developed must meet the criteria for quality learning tools that are effective, practical, and valid. Learning devices must also be developed following the applicable curriculum namely the 2013 curriculum.

The output of observations carried out at SMAN 1 Kecamatan Suliki on physics learning shows that the physics learning device used has not fully met the expected learning device criteria. In the lesson plans teachers have developed using a scientific approach and one of the learning models in the 2013 curriculum, it's just that in the implementation of the teacher has not been supported by teaching materials in the form of handouts or student worksheet that are appropriate so that the learning design in the lesson plans is difficult to realize. As a result, students' interest in learning physics is low, namely, 77% of students are not interested, even

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p_ISSN 2655-4852
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though the results of the analysis of 80% of students said they liked learning by experiment or experiment. If students actively follow the learning activities such as research or experiments, it should make learning physics more attractive and motivate students to learn.

On the other hand, students were not accustomed to looking for materials as other learning resources independently, this is based on an analysis that 73% of students were not accustomed to looking for other learning resources such as books or internet information. The low learning activities of students and the inability to add insight independently have impacts on the achievement of learners' competencies. It also will make the students weak in critical thinking which is indicated by a large number of silent students, do not ask questions, do not express ideas or opinions when learning takes place.

Learning that still does not emphasize the activities of students does not support learning physics which is a science that develops through scientific steps. Physics is a science that belongs to a group of sciences, therefore physics has the same characteristics as science, namely observing, experimenting, inferring, constructing theories, experimenting, and so are interrelated so on. Therefore learning physics should not only emphasize knowledge and understanding but also emphasize direct experience so it will train students to generate their reasoning and thinking skills in finding a concept.

The thinking skills needed in concept discovery and problem-solving are high order thinking skills abilities namely critical thinking skill. This critical thinking skill is not a skill that can develop by itself in line with human physical development but must be trained through the provision of stimulus that requires someone to think critically. King (2011) also explains that high order thinking skills will occur if someone retrieves new information and information stored in memory will be connected to expand information. Therefore students need to be helped to develop these skills.

The conclusion of these problems is the teacher needs to develop learning tools that emphasize the central role of students so that it will encourage students' critical thinking activities. The learning model that is suitable for increasing student learning activities is research-based learning. Learning with this model integrates research into learning so that it trains students to conduct experiments, make learning more meaningful by arranging hypotheses, collecting and processing data, drawing conclusions, and discussing. Through this learning model, it is expected that students will more actively follow the learning and master the concepts of physics, and improve their critical thinking skills. This corresponds to Usmeldi's and friends' research (2017) that found the research-based learning model is able to enhance critical thinking skills and student learning outcomes.

Based on the explanation, this research aims to produce physics learning devices using research based learning model. The development of learning devices done based on Permendikbud Number 81A 2013. The learning device developed in this study is specifically for impulse and momentum material contained in the subject in Semester 2 class X. Specifically, this device is signed to enhance students' critical thinking skills that can support the implementation of research-based learning or concept discovery.

2. METHOD

This study used the ADDIE model by Branch (2009). ADDIE model consists of five main stages namely Analyze, Design, Develop, Implement, and Evaluate. Students and physics teachers of SMA 1 Kecamatan Suliki were the respondents. The instruments in this study were

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validation sheets, practicality sheets, and effectiveness sheets. This study used practicality, validity, and effectiveness analysis as data technique analysis. Data analysis used percentages to measure validity and practicality value.

Learning devices are considered valid if the value of validity is more than 60%. The device developed in development research is said to be practical if the device can be applied in the field and the level of implementation is in a good category. The effectiveness of learning tools was determined by the competency assessment of attitudes, knowledge, and skills carried out at each meeting. The effectiveness of learning tools was calculated using a percentage with the provisions being in the effective category if 85% of students complete classically for attitudes, knowledge, and skills competencies. Meanwhile, the increase in knowledge competency in critical thinking skills was said to be effective based on the gain score category which was at least in the medium category.

3. RESULT AND DISCUSSION

3.1 Validity Result of Learning Devices

Learning devices which were lesson plans, syllabus, handouts, student worksheets, and assessments were validated by the validator. The validator assessed the learning tool which included content validity, construct validity, and language accuracy. The validity result of learning devices shown in Table 3.

Tabel 3. **Validity Result of Learning Devices**

Validated Device	Value of Validity (%)		Criteria
	Expert	Practitioner	
Syllabus	91,7	97,5	Valid
Lesson Plan	94,6	95,9	Valid
Handout	94,6	96,0	Valid
Student Worksheets	96,2	96,4	Valid
Assessment	95,2	92,4	Valid

Table 3 showed that all of the learning devices were valid.

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3.2 Practical Result of Learning Devices

The implementation of the learning devices in the class was observed during the learning. The practicality of learning devices was obtained from teachers and students responses. The practical result shown in Table 4.

Tabel 4. Practical Result of Learning Devices

Devices	Value of Practicality (%)			Criteria
	Teacher Response Questionnaire	Lesson Plan Implementation Observation	Student Response Questionnaire	

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Syllabus	95,0	-	-	Very Practical
Lesson Plan	95,0	93,2	-	Very Practical
Handout	91,7	-	85,0	Very Practical
StudentWorksheets	97,5	-	83,0	Very Practical
Assessment	93,8	-	-	Very Practical

Table 4 showed that research based learning devices were very practical.

3.3 Effectiveness Result of Learning Devices

Students' learning outcomes consist of knowledge competencies, skill competencies, and attitudes competencies. It is will show the effectiveness of learning devices. The effectiveness result of learning devices shown in Table 5.

Tabel 5. Effectiveness Result of Learning Devices

Effectiveness Data	Average Value	Category
Knowledge Competence	88,3	Effective
Behavior Competence	83,0	Effective
Skill Competence	83,8	Effective

Evaluation of knowledge competencies also included critical thinking skills. The critical thinking skills' assessment of each meeting is shown in Figure 1.

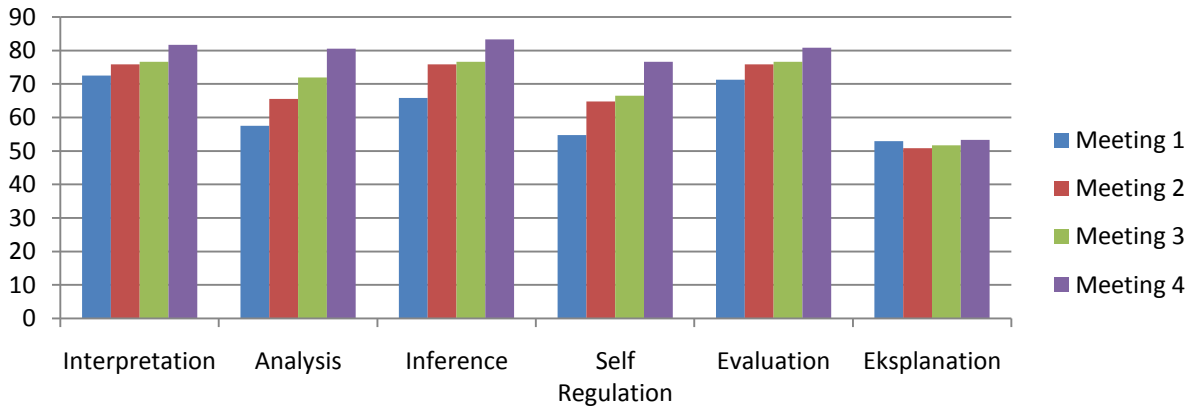

Figure 1. Results of Students' Critical Thinking Skills

Figure 1 showed that the indicator of the highest critical skills students have is an interpretation with an average of 76.7 with a critical category. Indicators of analysis, inference, self-regulation, and evaluation of mean values are also in the critical category. Meanwhile, the lowest indicator is explanation with value 52.2 and quite a critical category. This is caused by the fifth learning phase of research-based learning is presentation has limited opportunities so that not all students can appear. Overall the critical thinking skill indicator shows improvement in

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each meeting and the average is in the critical category. The Gain scores in this implementation class were 0.39 with moderate criteria. These criteria have a meaning that learning devices are effective in enhancing students' critical thinking skills.

3.4 Discussion

The validity result of learning devices showed that the learning devices developed were valid according to the aspect of measuring validity (construction validity, content, and language). The learning tool developed already meets the content validity criteria because in its development it has been based on the theory used in the guidelines for the formulation and preparation of the device. The learning device has fulfilled the construct validity because in its development has paid attention to the relationship between the components in the device and the compatibility of the device with the learning model used and the learning device has used the correct and correct Indonesian language and used the correct Indonesian Spelling (EYD). According to Nieveen (1999) one of the criteria for high-quality products or interventions is validity. Interventions or product development of learning tools will be a strong product because the quality is not in doubt. Thus a valid learning device is a quality product and a research-based learning device developed is feasible to be used so that it is expected to obtain valid research data as well.

The outputs of learning devices practicality were in the category of very practical. This shows that learning devices can help teachers in the teaching process because learning is no longer teacher-centered but student-centered. lesson plan implementation is in the category of very practical. This shows that the whole series of learning has been carried out well. Meanwhile, the outputs students' questionnaire responses also showed that the learning devices practicality in the category of very practical. Generally, this explains that research-based learning motivates students in learning the concept of physics which is being studied and helps them to understand it. According to Akker (1999) explains that practical product development refers to the level that users consider a product to be used and preferred under normal circumstances. Thus research-based learning tools can be used by students and teachers, helping teachers in the preparation, implementation, and assessment of the learning process.

The learning device's effectiveness can be noticed in the acquisition of the outcomes' value of student learning from attitude competence, knowledge, and skills. The value of learning outcomes obtained at the implementation stage and the stage of each of 4 meetings. At this stage, an average knowledge competency score of 78.5 was obtained with classical completeness of 88.3%. The average result of attitude competence was 83.0 with classical completeness of 95.0%. The average result of skills competence was 83.8 with classical completeness of 91.7%.

Therefore, it can be concluded that the research-based learning devices developed have met a practical, effective, and valid category in enhancing critical thinking skills. This proves that research-based learning gives significant effects toward critical thinking skills, and this corresponds with Usmeldi's research, et al (2017) in their study develop research based learning models by using science, environment, technology, and society approaches which is valid, practical, and effective to enhance students' critical thinking skills. The device developed is also effective for students' knowledge, attitudes, and skills competencies. The outcomes of this study correspond to Widyasari (2019) who invented implementation of research-based learning was effective for understanding students' material. Usmeldi (2015) in his research found the

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p_ISSN 2655-4852
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effectiveness research-based learning to enhance students' understanding of physics concepts. Research-based learning tools are effective for improving students' attitude competency (Usmeldi, 2016). Liu and Li (2011) concluded research-based learning is able to enhance students' enthusiastic attitudes in learning. Prahmana and Darhim (2016) in their research found research-based learning is able to foster students 'research skills and Trisnasih (2013) through their research concluded research-based learning is able to enhance students' process skills.

Students receive opportunities in research-based learning activities to carry out real learning through research and find concepts by concluding the outputs of finished research. The experience of learning is able to enhance students' critical thinking skills. According to Subiantoro (2009) a person's critical thinking skills are strongly influenced by his learning experience. Research-based learning arranges hypotheses, collects and processes data, and draws conclusions by discussing in groups. This activity focuses on the learning experience on the students so that it gives an impact on the learners' critical thinking skills. Research based learning not only enhances critical thinking skills but also makes students achieve their competencies well, namely knowledge, attitudes, and skills competencies.

4. CONCLUSION

This research had developed learning devices that are valid based on validator assessment consist of 3 expert validators and 2 validator practitioners. The valid learning devices consist of lesson plans, student worksheets, syllabus, handouts, and assessment tools. Learning devices developed are very practical. The practicality of the equipment is obtained through teacher questionnaire responses. The practicality of the lesson plan is also obtained by observing the implementation of the lesson plan in class. The practicality of handouts and student worksheet is also obtained through the questionnaire responses of students after using handouts and student worksheets. The learning tools which have been developed are effective for enhance critical thinking skills for students, furthermore, the devices' effectiveness is also obtained in students' learning outcomes for knowledge competencies, attitudes, and skills.

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Vol. 2 No. 2 (pp. 66-72) June 2020
p_ISSN 2655-4852
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