Developing of physics teaching materials based on authentic learning to train problem-solving skills

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Abstract. Authentic learning as a means that allows students to develop knowledge transferred to real-world practice. This research aimed at determining the validity, the practicality and the effectivity of the use of physics teaching materials based on authentic learning. This research type is a research and development using the ADDIE model. The subjects of the trial were 33 students of class X at one of the high schools in Banjarmasin. The research instruments were validation sheets, observation sheets for lesson plan implementation, student achievement results and problem-solving skills assessment sheets. The results showed that: (1) the validity of the Physics teaching materials based on authentic learning was very high with an average value of 3.68, (2) practicality with an average of 3.68 criteria very high, (3) effective in improving aspects of knowledge of students who are classified as moderate with a gain score of 0.6 and problem-solving skills is adequately trained. It was concluded that the physics teaching materials based on authentic learning were declared valid, practical and effective to train problem-solving skills. This problem-solving skills is also useful for students to get success in real life.

1. Introduction
The activeness of students in learning physics in class lies in two aspects, namely hands-on activity and minds on activity. Students who can link new information with prior knowledge can develop their ideas to help solve problems [1]. But students are still difficult to combine the two. This is because, in the process of learning, the teacher does not facilitate teaching it. Students are less able to connect the context of learning science amid real life. Students are used to solving simple problems, but students have difficulty solving more complex problems [2].

The results showed that high school students experienced difficulties in solving physics problems [3]. This is caused by several factors, including the material they learn, classroom learning activities and teacher teaching styles. Students lack interest in problems solving due to the length and complexity of the problems [4]. Students unable to problem-solving skills include not enough practicum in the laboratory, confused writing unit conversions, lack of physics books used as references [5].

Based on the interview that the researcher did with one of the teachers at one of the high schools in Banjarmasin stated that class X did not have physics teaching materials in learning. Students only get learning material based on what the teacher delivered in the classroom, and this causes students to be passive in class. Physics teaching materials that are not yet available affect student learning outcomes. Based on the daily test results of students, especially students of class X MIA 3, only 22% or 7 of the 32 students were by the standard of completeness, while 78% or 25 students were below the applicable completeness standard. These learning outcomes show that learning is still not successful. The skills of
students who are still low can also be seen from the questions trained by the teacher when learning only reaches the application category (C3) so that students have not trained in problem-solving skills or high-level thinking skills. The difficulty of solving physics problems in students must be addressed immediately. Students need the problem-solving skills related to life activities in the community where they will live and work. So physics teaching materials are needed to practice problem solving skills.

Problem solving skills taught in learning physics must be based on constructivist theory that knowledge must be built by students. The teacher helps students build their knowledge [6]. Science learning in schools could be applied by connecting materials in learning with real life [7]. As a consequence, innovative learning strategies or approaches are needed to make them real.

Two innovative approaches are authentic learning and inquiry approaches. Authentic learning is a learning strategy that requires students to explore contextual knowledge to promote learning related to settings, activities and others [8]. Authentic learning provides a means by which students can socialize their knowledge with real-world students. Authentic learning is becoming more commonly used in higher education such as mathematics [9], educational technology [10], language [11], and science [12]. The advantages of authentic learning are that it can increase student motivation and reflect positively on their learning process [13].

Authentic learning design also has potential strengths to improve reflection on student education. Authentic learning was first used in learning English, but now it is also widely used in scientific disciplines from elementary school to tertiary education [12]. In authentic learning, students do activities using real world resources to overcome real problems by thinking and acting like professionals [14].

In authentic learning students are given the opportunity to ask questions actively, solve problems and think critically to reflect on problems in everyday life. Using authentic learning can make students to observe phenomena in the real world and make it a learning bucket. The actual problems of the real world need to be emphasized in the authentic learning process. Because of the reasons mentioned above, students need to face authentic problems in class to involve learning more.

Teaching materials are needed for authentic learning. Complete learning material will help teachers and students in the learning process. Learning material ensures to achieve learning goals. Systematic learning materials to be trained to solve problems are difficult to find. The student books used are still not based on real problems, so that makes students less interested in physics books. Based on this background, it is necessary to develop physics teaching materials based on authentic learning to train problem-solving skills. This research aims to determine the validity of physics teaching materials based on authentic learning, examining the practicality and effectiveness of the use of physics teaching materials based on authentic learning.

2. Methods
This type of research is a type of development research using the ADDIE development model. The stages carried out based on the ADDIE model are: 1) analyze the curriculum, student characteristics and material characteristics, 2) design learning strategies, 3) develop products and conduct validation, 4) implementation of testing on developed products and 5) evaluations at each stage of the development process [15]. The research was conducted to develop a physics learning material based on authentic learning to train the problem-solving skills on the topic of work and energy. The subjects of the study were 33 students of class X at one of the high schools in Banjarmasin in the school year 2017/2018 by using One-Group Pretest-Posttest Design because this research was applied in one group without any comparison group.
### Table 1. Data, Data Collecting Method, and Instrument

| Data | Data Collecting Method | Instrument |
|------|------------------------|------------|
| The validity of physics teaching materials based on authentic learning. | Product validation by the experts and teacher physics | Validation sheet |
| The practicality of physics teaching materials based on authentic learning. | Observation of implementation of the lesson plan | Observation sheet |
| The effectivity of the use of physics teaching materials based on authentic learning. | Assessment of test | Evaluation test |

Analysis of the results of the validity of physics teaching materials was obtained from the calculation of the percentage of expert validation results. The practicality analysis of physics teaching materials was obtained from the average calculation of the results of the observation of the lesson plan. As well as the analysis of the effectiveness of physics teaching materials obtained from the calculation of the gain score from the value of the pretest and posttest conducted at the beginning and end of learning.

### 3. Results and Discussion

Based on curriculum analysis applied in schools using the 2013 curriculum with essential competencies of knowledge is analyzing the concepts of energy, work, relations to work and changes in energy, the law of energy dissipation, and its application in everyday events. Based on these competencies, teaching materials must be taught by linking to events in the real world. The characteristics of this learning material emphasize solving problems related to everyday life through authentic learning to practice problem solving skills.

Based on observations, the characteristics of students in at one of the high schools in Banjarmasin especially in class X MIA 3 can be categorized as students who are less independent. Learning in the classroom is only one direction from the teacher, so students are not active in learning. Students are only used to solving simple problems, unable to solve complex problems.

Learning material is focused on practicing problem-solving skills because they are essential things that must be developed as the demands of the 21st century. Physics learning material developed is a textbook on business materials and energy. The novelty of the textbook section that has been developed is (1) study case; (2) let’s find out; (3) problem solving plan; (4) Investigation activities.

The existence of a study case provided in physics teaching materials is used to present students' real-world problems, and by the learning, the approach used, namely authentic learning. Besides the study case by the real life of students also adjusted so that the problems provided can be investigated through experiments. The existence of a study case can help students more easily identify problems. In the section Let's find out on physics teaching materials, the question is adjusted to the indicator of problem solving. Let’s find out what is provided in physics teaching materials can help students in gathering information about learning materials that support solving problems in the study case. The question on let's find out is also adjusted to the information needed to solve the problem in the study case. The problem-solving plan contained in the physics teaching materials is in the form of questions that guide students to plan the resolution of problems in the study case. The investigation activities provided in the physics teaching materials have been adjusted to the problems in the study case. The investigation activities provided in the physics teaching materials consist of tools and materials, investigation procedures, data analysis questions, conclusions, and problem-solving questions that are provided in the physics teaching materials in sequence. Authentic learning is characterized by problems in the real world, investigative activities to help improve student thinking, collaborate, use various learning resources, and or reflect.
Validation of physics teaching material is carried out by three experts. The result was in Table 2. Table 2 shows that the physics learning material developed was considered as very high with a mean score of 3.68. As for the suggestions and criticisms of the validator on physics teaching material is an indicator of learning focused on the activity of problem-solving skills so that researchers improve learning indicators.

| Table 2. Validation Results of Physics Teaching Materials |
|----------------------------------------------------------|
| Aspect        | Score | Category |
| Format        | 3.61  | Very high |
| Display       | 3.70  | Very high |
| Language      | 3.68  | Very high |
| Benefit       | 3.78  | Very high |
| Content       | 3.63  | Very high |
| Mean          | 3.68  | Very high |

Physics teaching material developed has been corrected according to the advice of the validator. All experts assessed that the physics teaching material developed was based on authentic learning including contextual problems that were included in the study case and investigation activities. The practicality of physics teaching materials is determined by the implementation of the lesson plan. The implementation of the lesson in each phase of learning using physics teaching material used has good implementation. The implementation of the lesson plan obtained is due to the role of physics teaching material that is valid in learning, and there is always evaluation at each end of learning.

The effectiveness of physics teaching materials is measured based on student learning outcomes, namely the value of the pretest and posttest which is then calculated the gain score.

| Table 3. Results of pretest and posttest |
|----------------------------------------|
| Average Pretest | Average Posttest | <g> | Category |
| 8.02           | 62.40            | 0.6 | medium   |

Based on Table 3, the average pretest value and the average posttest value were obtained. This value indicates that there is an increase in the results of the pretest against the posttest results. So that the gain score obtained in the medium category. The average posttest results show that students still do not master the concept. This is due to the learning process using physics teaching materials for only three meetings for two weeks. Student knowledge can improve when students are given the opportunity to participate in investigative activities to solve contextual problems continuously [2]. so it is not enough for two weeks for this authentic learning. This is also supported by the results of a study by Coskun [12] that authentic learning shows a good perspective after being applied for weeks. Long-term memory and understanding of students can be improved through authentic learning environments [16]. Students must continue to be trained using authentic learning for a long time.

| Table 4. Student’s problem-solving skills |
|-----------------------------------------|
| Problem-solving indicators | Average Score | Category score |
| Identification of problems     | 4.29 | Very Good |
| Gathering Information          | 3.71 | Good      |
| Conduct an Experiment          | 3.46 | Good      |
| Data analysis                  | 3.92 | Good      |
| Conclude                       | 3.42 | Good      |
| Presenting Works               | 3.80 | Good      |
| Mean                           | 3.77 | Good      |

Table 4 shows that students’ problem-solving skills are in a good category. The first indicator of problem-solving skills is the identification of problems. It can be seen that the average problem-
solving skills can be categorized as good. Problem-solving skills according to Arends [17] consist of six stages of problem-solving, namely problem identification, gathering information, conducting investigations, analyzing data, drawing conclusions, and presenting the work. Indicators of problem-solving for students who are among the best categories are indicators of problem identification. Good problem identification ability because the physics teaching materials provide authentic problems. The problems provided can also be found in real life and are more complex, so students are required to understand and identify these problems. This shows that the use of physics teaching material can train students' problem-solving skills. This is in line with the opinion of Banas & York [8] states that's authentic learning that is focused on problems that might be found in everyday life will create conditions that require students to improve their problem-solving skills to find solutions. Being able to understand and identify a problem will greatly help train students' problem-solving skills [18]. When identifying problems, make students think about life problems and apply their knowledge to gather relevant information to provide solutions. Indicator problem-solving skills for students who are included in the lowest category compared to other indicators is the skills to conduct investigations. The skills to carry out the lowest investigation of students is influenced by the characteristics of students who rarely conduct investigations so that the science process skills to conduct an investigation get the lowest score. In line with previous result that process skills are not possible to grow optimally naturally, but must be consciously developed to achieve full appearance[19].

Based on the results of this study, it can be stated that students' problem-solving skills can be categorized as good because they are supported by authentic learning physics teaching materials that train students' problem-solving skills. Students who have been trained in problem-solving skills will have greater motivation to learn and have a better understanding of concepts [20]. Physics teaching materials based on authentic learning are arranged systematically to train the indicators of problemsolving to be assessed. Learning can be said to be authentic if done by bringing problems in the real world related to material topics and trying to solve problems [2].

4. Conclusion
Based on the results and discussion, it can be concluded that physics teaching materials based on authentic learning developed were declared valid, practical, and effective to train problem-solving skills. This problem-solving skill is also useful for students to get success in real life.

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