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Development of work and energy encyclopedia based on science technology society

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Abstract

This study aims to develop work and energy encyclopedias based on Science Technology Society (STS), that is suitable for use as a source of learning. The method that used in this research is Research and Development (R&D) with the ADDIE model. ADDIE is an acronym of Analysis, Design, Development, Implementation, and Evaluation. As a result, the encyclopedia developed based on scientific approach can improve high school students' learning outcomes. In conclusion, the work and energy encyclopedia that was developed based on Science, Technology, and Society (STS) is feasible to be used as a learning resource in physics subject.

Keywords: encyclopedia, energy, work, education, technology.

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Desarrollo de enciclopedia de trabajo y energía basada en la ciencia, la sociedad tecnológica

Resumen

Este estudio tiene como objetivo desarrollar enciclopedias de trabajo y energía basadas en la Sociedad de Tecnología Científica (STS), que es adecuado para su uso como fuente de aprendizaje. El método utilizado en esta investigación es Investigación y Desarrollo (I + D) con el modelo ADDIE. ADDIE es un acrónimo de Análisis, Diseño, Desarrollo, Implementación y Evaluación. Como resultado, la enciclopedia desarrollada en base al enfoque científico puede mejorar los resultados de aprendizaje de los estudiantes de secundaria. En conclusión, la enciclopedia de trabajo y energía desarrollada en base a Ciencia, Tecnología y Sociedad (STS) es factible para ser utilizada como un recurso de aprendizaje en materia de física.

Palabras clave: enciclopedia, energía, trabajo, educación, tecnología.

1. INTRODUCTION

Twenty-first-century education is expected to shape students to be more ready to face globalization era, environmental issues, and information technology progress, which is one of important foundations in nation-building. One of science education goals is to prepare students to have ability in understanding science in their daily life. The curriculum should give understanding of science-based on individual needs, besides giving chance to students to get involved in social problems either in local, national, or global scales. Students, that

are also as citizens, should have good competence to well participate in society they live in.

One of instructional principle is a learning based on various learning resources. Based on the analysis of high school students' needs in Bekasi region with total respondents of 118, obtained information that 81.5% of the students claimed that limited learning resources caused less understanding in physics material. 90.8% of students claimed that new additional learning resources in physics are needed. The additional learning resource that can be used in physics is encyclopedia, but 58% of the students have not known about encyclopedia and only 10.1% of students have used it as a learning resource.

The encyclopedia is a reference that provides complete fundamental information about various problems in various fields or branches of science. The purpose of encyclopedia publication is to summarize and organize knowledge accumulation and to attract readers. Reference utilization is very helpful and even indispensable for students to achieve their educational outcomes. Reference utilization is one of the most important parts of an academic practice process.

The instructional model that can improve understanding in science and scientific literacy in Science, Technology, and Society (ABUALROB & SHAH, 2012; AHMAD & AHMAD, 2018). Science, Technology, and Society (STS) instructional model connect science and technology with their benefits in society (BRANCH, 2009). By connecting the instruction of science and technology with their

benefits and need in society, it is expected that the concepts that have been learned and understood can be beneficial for the learners and can be used to solve the problems they face or to overcome social environment issues. The instructional activity of Science, Technology, and Society conducted continually may realize scientific instructional goal, that is developing scientifically literate students (RUSNAYATI, STEFANI & WIJAYA, 2015).

Based on respondents' ability test that was performed on twelfth-grade students in SMA Laboratorium Percontohan UPI (SALEH & SUJANA, 2009; AHMAD &AHMAD; 2018), know that the students have difficulty in understanding about energy and kinetic energy concepts. The result of analysis of needs with high school teachers in Bekasi region obtained information that students have difficulty in understanding work and energy concept and one of the causes is limited learning resources. Based on the description above, it is considered to develop work and energy encyclopedia based on Science, Technology, and Society.

2. METHODOLOGY

The research method used was Research & Development (R&D) with ADDIE development model. ADDIE is an acronym of Analysis, Design, Development, Implementation, and Evaluation (AKGUL, 2004). In the step of analysis, it was analyzed the gap between expectation and reality. The procedures were conducted by performing

analysis of needs by giving questionnaire to students and teachers; determining the intended students; and identifying the required resources (RAHAYUNI, 2016).

The procedures conducted in the step of the design were determining the goals that would be achieved by students after performing the instructions; determining proper strategies, methods, and instructional media. In the step of development, the design was realized to become a real product, that was product of encyclopedia with the contents of work and energy. The encyclopedia was validated by instructional media experts, content experts, and instructional method experts. After the validation, the encyclopedia was revised based on experts' suggestion and assessment, and then a field test was conducted on students. The target of the field test of the encyclopedia was high school students. In the step of implementation, the encyclopedia was used by students as a learning resource. The procedure conducted in the step of evaluation was evaluating students who had used the encyclopedia.

3. RESULT AND DISCUSSION

The encyclopedia was developed based on Science, Technology, and Society (STS) with the steps of introduction, concept development, real-life application, concept reinforcement, and evaluation. This was confirmed by Abu Alrob and Shah who stated in their report that development of science instructional material should

be based on the development of Science, Technology, and Society (STS) to ensure that the students obtain benefit from the scientific content (IROAGANACHI & ILOGHO, 2012). Science, Technology, and Society help students to develop concepts, creativity, attitude toward science, and knowledge and basic competence in science, including problem-solving and skill to explore self-knowledge (LIVERSIDGE, COCHRANE, KERFOOT, & THOMAS, 2010). In accordance with the study by Klahan and Yuenyong that concluded that the strength of science learning through Science, Technology, and Society (STS) is (1) science learning regarding the nature of science, (2) awareness about connection between science, technology, and society, (3) improving students' independent learning, and (4) scientific attitude toward physics learning (SOOBARD & RANNIKMAE, 2011).

The step of STS consists of an introduction, concept development, real-life application, concept reinforcement, and evaluation. The introduction can be referred to as initiation or beginning, and can also be referred to as invitation, that is an invitation for students to pay attention to the instruction. Real-life apperception also can be done, that is by relating events that have been known by students with the material that will be discussed so that a knowledge correlation is noticeable because it begins with the things that have been known by students that are emphasized on the daily life circumstances. Concept development can be performed by various methods.

At the end of the concept development, students are expected to understand whether analysis of issues or problem solving described at the beginning of the instruction has applied concepts followed by scientists. With a good conceptual understanding, students perform analysis of issues or problem solving that is referred to as real-life concept application. Then, concept reinforcement needs to be performed by reinforcing important key concepts that should be known in certain learning material. And the last is students' evaluation (AKGUL, 2004). The encyclopedia contains materials of Work and Energy. The sections are work, potential energy, kinetic energy, work-energy theorem, power, and energy sources. Components of the encyclopedia are cover, instructions of use, content, and index (Figures 1 and 2).

Figure 1: Front and back cover display of the encyclopedia.

Figure 2: Content display of the encyclopedia.

Validation tests performed by media experts with the aspects of content, presentation, language, and usefulness resulted in average percentage of 91.35% (Figure 3). The validation test performed by content experts with the aspects of content and presentation resulted in average percentage of 85.16% (Figure 4). Validation test performed by instructional method experts with the aspects of content, presentation, instruction of Science, Technology, and Society, and language resulted in average percentage of 95.11% (Figure 5).

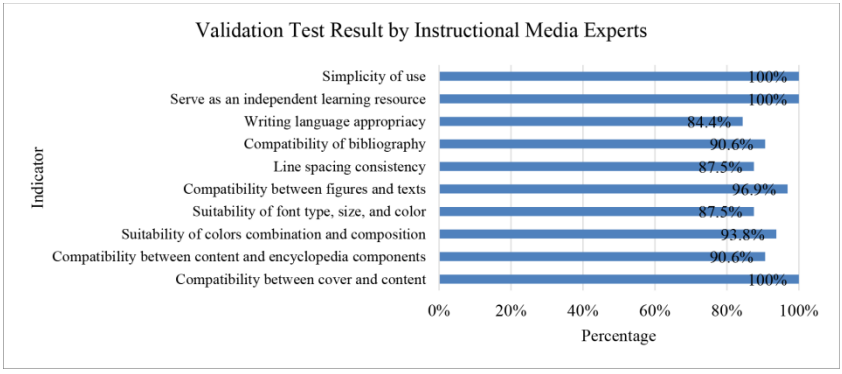

Figure 3: Validation Test by Instructional Media Experts.

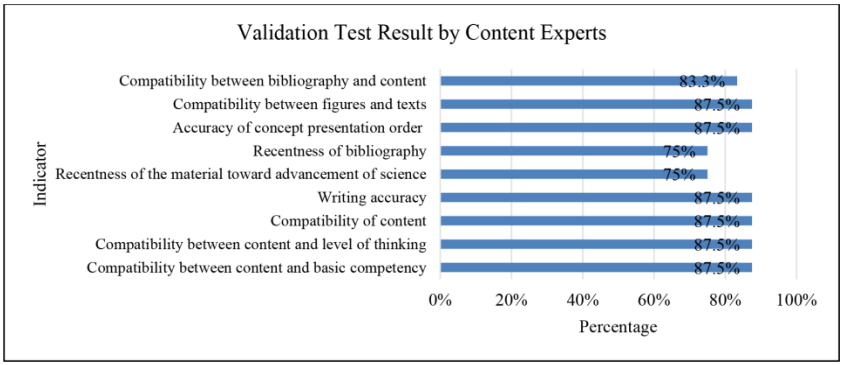

Figure 4: Validation Test by Content Experts.

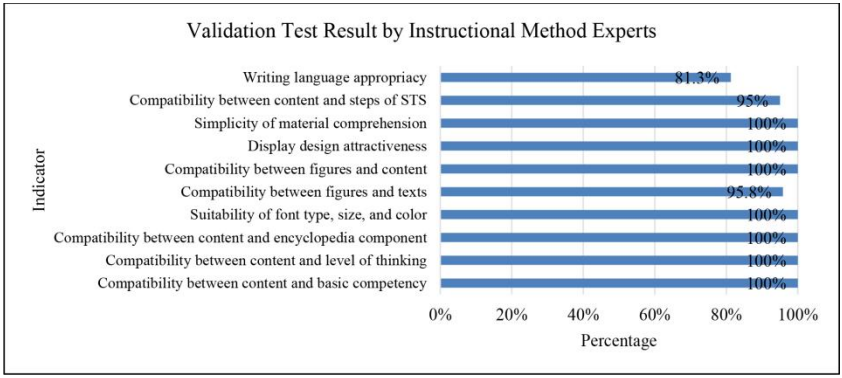

Figure 5: Validation Test by Instructional Method Experts.

The average score of validation test results performed by instructional media experts, content experts, and instructional method experts is 90.54% that was interpreted as “very good”. Field tests performed on 5 high school students with the aspects of content, presentation, language, and usefulness resulted in average of 90.31%. This result is interpreted as “very good”. In accordance with the study conducted by Nurafifah, reported that the encyclopedia developed

based on scientific approach can improve high school students' learning outcomes.

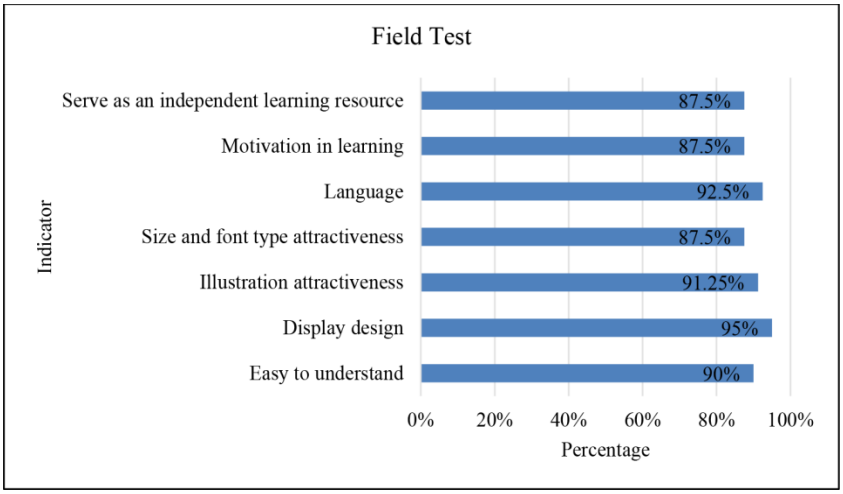

Figure 6: Field Test Result on Students.

4. CONCLUSION

Based on the result and discussion, it is concluded that the work and energy encyclopedia that was developed based on Science, Technology, and Society (STS) is feasible to be used as a learning resource in physics subject.

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