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The Development of Electronic-based Student Worksheets to Facilitate the Critical Thinking Skills of Tenth Graders

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ABSTRACT

Smartphones become something familiar to learners. Most learners have smartphones. Learners require guidance to use smartphones for learning. This matter becomes the principle of developing an electronic-based worksheet. Based on the encountered problems especially the materials about renewable energy and critical thinking, the learners needed the development of an electronic-based worksheet to facilitate their cognitive skills within the material of renewable energy. This research and development, R&D, applied the 4D design, starting from defining, designing, developing, and disseminating. However, this research only lasted until the development stage specifically the limited test. The result showed the category of extremely excellent from the learners. On the other hand, the implementation of the whole aspect was done excellently.

INTISARI

Smartphone bukanlah hal yang asing bagi peserta didik. Setiap peserta didik tentu memilikinya. Sebagai seorang pelajar, penggunaan *smartphone* perlu diarahkan agar menjadi bermanfaat dalam pembelajaran. Hal tersebut mendasari pengembangan bahan ajar LKPD berbasis elektronik. Berdasarkan kendala pada pembelajaran, terutama pada materi energi terbarukan dan kemampuan berpikirkritis. Maka, LKPD berbasis elektronik dikembangkan dengan tujuan memfasilitasi kemampuan berpikir kritis pada materi energi terbarukan. Penelitian ini merupakan penelitian *Research and Development (RnD)* dengan model pengembangan 4D (*Four-D*) yang terdiri dari *Define, Design, Develop, and Disseminate.* penelitian ini dibatasi sampai *Develop* (Pengembangan) pada uji coba terbatas. Hasil respon peserta didik yaitu Sangat Baik (SB). Sedangkan hasil keterlaksanaan seluruh aspek dapat terlaksana dengan baik.

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A. Introduction

The technological development in Indonesia is significant, such as the Internet development. Sasmita [1] argues that the increased numbers of Internet users lead to increased benefits of the Internet. Montanesa [2] explain that adolescents and the Internet are strongly associated. On the other hand, the Internet brings both positive and negative impacts to the Internet for the users, to realize excellent Internet implementation. Gunawan [3] explain that survey about Internet addiction in 204. The results found that 41.7% of learners aged between 12 and 25 years old had Internet addiction. Dewi [4] explain that Internet addiction in adolescents worsens daily life matters, starting from inter-individual interaction, learning concentration, and poor sleeping quality. Dewi [4] found that eleventh graders of Senior High School with smartphone addiction and those without smartphone addiction were also balanced, 50.16% and 49.84%. On the other hand, the longest duration of using a smartphone by the learners was 5 hours. The technological implementation skills of adolescents require appreciation and direction, especially in terms of the educational field.

Husamah [5] explain that education refers to the interactive process between learners and educators to realize educational objectives. Therefore, the efforts to achieve the objectives require other educational factors and basic values. The educational factor may include the infrastructure, the delivered material, the media, and the applied methods. Learning media could create an effective learning process, accelerate learning, and improve the learning quality [6]. Learning media that uses technological and smartphone developments is called mobile learning. The implementation is flexible to be anywhere and anytime [7]. Mobile learning refers to a suitable learning media because this media is installable on a smartphone. Moreover, the smartphone has a proportional size and is portable to bring anywhere compared to a laptop computer. If learners had excellent skills in using smartphones, the media would have easy implementation. For example, mobile learning at schools could be electronic books, e-modules, and e-worksheets.

Worksheet refers to media that learners use. The media contains procedures of activities for the learners to promote base don the targeted learning objectives [8]. Arianto [9] define worksheets as teaching materials to facilitate learners in improving their understanding and the concept of scientific nature. Firdaus [10] explain that a worksheet refers to an activity sheet for learners to find concepts and train their critical thinking skills. Critical thinking is an important skill for this 21st century. The era demands that learners have excellent thinking skills [11].

Critical thinking becomes one of the science educational objectives, providing positive impacts on daily life and creating readily attitude of the learners with various science disciplines [12]. Samsudi explains an important educational objective is critical thinking skills [12]. The skill refers to inductive-deductive thinking by expressing ideas. Critical thinking realization of the learners occurs when the learners

encounter new matters to solve by associating the obtained information [11]. Critical thinking skill realizes excellent learning because of the active participation and curiosity of the learners. In this learning, teachers act as facilitators, moderators, and motivators [13]. Besides that, critical thinking also prepares the learners to rationally and logically think; and solve problems [14]. The Merdeka curriculum demands learners to have critical thinking skills.

Based on the interviews with the teachers, the researchers found that the implementation of smartphones was not maximum although the learners were habituated to using it while in online learning. Therefore, the learners still used printed books. The encountered problems by the learners were observable when they worked on the questions, such as analyzing and elaborating on the problems. The teachers thought the learners had difficulties while learning about renewable energy. The researchers held a forum of group discussion with 36 learners. Before discussing, the learners filled out the questionnaire about their learning style. Based on the questionnaire, 33 learners seemed to have a visual learning style while the others had a kinesthetic learning style. The first forum of group discussion dealt with physics learning with a lecturing strategy to make the learners understand. However, when the learners worked on the questions, they were confused to use the equation. The learners attempted to prevent the situation by actively asking and working on the questions. The second FGD dealt with the assumption of difficult materials. The researchers found many learners thought the materials difficult because they were confused to use the equation, especially the direction and displacement. The difficult materials included the planetary and parabolic patterns and the renewable energy materials. Learners argued that the material of renewable energy was difficult because the material was correlated to the surrounding environment. However, when the learners worked on the questions, they encountered difficulties in working and analyzing the renewable energy from the surrounding environment.

The focus of the following discussion dealt with the activeness of the learners in comprehending, working on the question, and finding other sources. Most learners were not trained to work on the questions independently at home. However, based on the interview, learners realized the importance of learning sources to comprehend the material. This action was important because the textbook provided limited questions for exercising. The fourth discussion focus dealt with the power and energy of the renewable energy chapter. The obtained answers from the learners indicated that they understood the materials because they had similar materials at Junior High Schools. However, while studying at senior high schools, the learners found the materials tended to be something related to renewable energy. The material became something new for the learners to study. The encountered difficulties by the learners were: confusion while using the equation; difficulty related to motion, direction, and displacement; question difficulty compared to the junior high school levels; incomplete comprehension while learning about power in physics; and incomplete

understanding of the correlation between the renewable energy and the environment such as the positive and negative impacts and the potency of the renewable energy.

The focus of the fifth discussion deals with critical thinking. The learners could not understand the essence of critical thinking. Then, the sixth discussion deals with the implementation of gadgets for learning. The learners preferred smartphones to learning with laptop computers. The reason was - the learners had excellent smartphones with high specifications to support their learning. They also found that smartphones were more practical than laptop computers for learning so they could leave the use of paper. The focus of the last discussion deals with the expected physics learning by the learners. The learners expected that the learning would be convenient; have many question exercises; provide practices; and use technology for learning such as gadgets or the Internet. Based on the interview results, the researchers found that the electronic-based worksheet could facilitate the critical thinking of the learners about the material of renewable energy.

B. Method

This research is an R&D (Research and Development). The applied research model is 4D, consisting of defining, designing, developing, and disseminating [15]. However, this research only took the development stage with limited tests. In this stage, the researchers involved the tenth graders, 15 learners. The product of this research was the electronic-based worksheet to facilitate the critical thinking skills of the tenth graders about renewable energy.

C. Results and Discussion

In this research, the researchers validated the electronic-based worksheet. The validation of the expert material obtained a score of 3.7, extremely excellent; and the media expert validation obtained a score of 3.6, extremely excellent. The researchers also assessed the product by the material expert, media expert, and teacher. The obtained results are consecutively 4, 3.6, and 3.7.

Then, the researchers promoted a limited test for 15 individuals in the tenth grade. The responses show that the learners agreed with the product. The obtained mean is 0.93. The responses cover the content, critical thinking skills, language, display, figure and video, and application language.

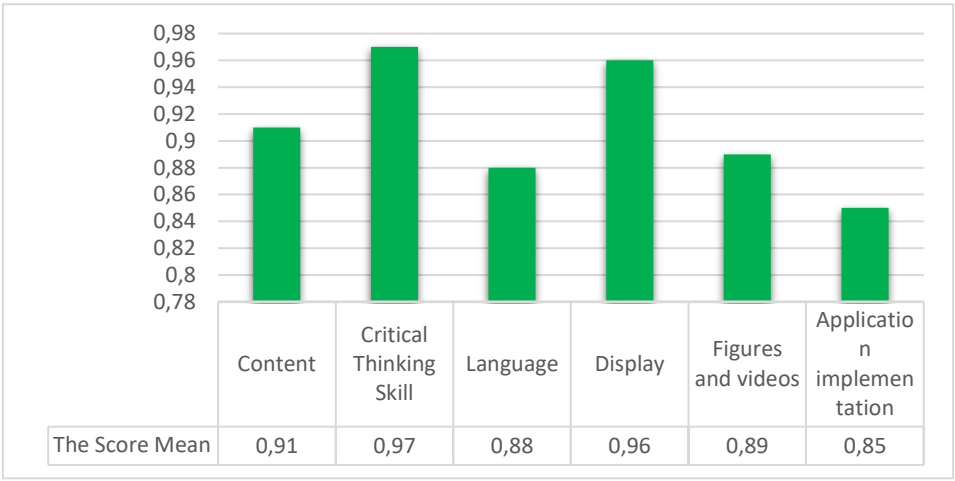

Figure 3.1. The Graphics of the Learner Response Mean toward Each Aspect

The researchers promoted the test to examine the developed teaching material implementation in the learning process. The participants remained the same, the tenth graders consisting of 15 individuals. In this process, the researchers directed the learners to use the electronic-based worksheet named "*Energi Terbarukan,"* or "Renewable Energy." In this stage, the researchers directed the learners step-by-step so all learners could install the application. Then, the researchers explained the worksheet implementation. Eventually, the learners worked on the worksheet with three worksheets in groups while the other one was with individual working. After the learning process, the learners filled in the sheet of implementation.

On the other hand, the learners had to fill out a sheet about convenience, interest, content, and critical thinking skills. The first aspect deals with convenience. This aspect obtains a score of 0.8. This matter indicates that the learners feel convenient while using the electronic-based worksheet. They also found the installation was easy. They also effortlessly used the electronic-based worksheet. The aspect of interest had an excellent realization. The obtained mean is 0.9. This matter shows that the learners are interested in the display of the worksheet, the color composition, the size, and the font type. For the aspect of content, the obtained score of this aspect is 0.8. This matter indicates that the learners could understand the read articles, answer the question while having learning activity, and find the developed worksheet useful to comprehend the material about renewable energy.

The developed worksheet could facilitate critical thinking skills. Thus, the aspect of implementation also had the aspect of critical thinking skills on each worksheet indicator. The first indicator is interpretation. Dealing with this indicator, the researchers found 4 learners who could not identify the problems from the read articles in the first worksheet. However, the other eleven learners could identify the

problems from the article excellently. On the other hand, all learners with the first, third, and fourth worksheets found the learning activities assisted them in understanding and interpreting the problems. Learners could answer the questions by observing, analyzing, and expressing the problems from the articles they read. Thus, the aspect of critical thinking, based on the indicator of interpretation of the learning activity, ran excellently.

The second indicator is analysis. In this indicator, the learners learned and practiced to train their analytical skills. The first worksheet implementation showed excellent implementation. The result shows that the learners could answer the questions while the learning activity was based on the indicator of analysis. One of the learners during the implementation of the worksheet found he could answer and explain the question about energy dynamics. In the second worksheet, the questions about indicators of analysis consisted of two items. For each item, fourteen learners agreed with the capability of the questions to facilitate the learners' analytical skills. However, the researchers found a learners could not perform this skill. Based on the data, the learners with difficulty with this indicator also could not interpret as found in the interpretative indicator. In the third worksheet, the researchers found one learner who could not analyze problems. However, in this third worksheet, the learners did not encounter any difficulty in the indicator of interpreting. Thus, the researchers concluded that the directive questions toward the indicator of analysis were not excellent. On the other hand, fourteen learners could answer the questions related to the indicator of analysis. Eventually, in the fourth worksheet, fourteen learners found the learning activity and practice could facilitate the learners to analyze. However, a learner assumed something different. Overall, based on the obtained data from the sheet of implementation, the learners had excellent critical thinking skills based on the analytical indicator. This matter indicates that the electronic-based worksheet could facilitate the critical thinking skills of the learners based on the analytical indicator. The interview results found that learners had difficulties while analyzing problems.

The third indicator is evaluation. In this indicator, the first worksheet had an excellent promotion, proven by the responses of thirteen learners. They agreed with the indicator. On the other hand, two learners encountered difficulties while elaborating on the problems. In the second worksheet, fourteen learners found that learning could facilitate the learners in explaining the problems. On the other hand, one learner did not find so. Previously, the learners also had difficulties with the interpreting indicator. Then, in the third worksheet, the researchers found the same results as the previous worksheet. The researchers found one learner who could not elaborate on the problems. The same problem was observable in the learners in the second worksheet. On the other hand, in the third and fourth worksheets specifically in the analytical indicator, the learners also found the difficult to analyze the problems.

The learners explained the difficulties because the learners did not maximally understand the problems. They also found the questions were long and provided them with multiple interpretations. However, in the fourth worksheet especially the evaluation indicator, the learners could answer the questions. All learners agreed with the fourth worksheet that provided the indicator of evaluation. They could evaluate excellently. Based on the answers, the learners could demonstrate excellent evaluation. This matter indicates that the learning and the practice could facilitate the critical thinking skills of the learners based on the indicator of evaluation. The final indicator is the conclusion. All learners could answer and conclude the learning activity. This matter shows that the indicator has excellent implementation in learning. Thus, the indicator of conclusion could facilitate the critical thinking skills of the learners in the learning.

Based on the sheet of the implementation, the researchers concluded that the aspects, starting from the convenience, interest, content, and critical thinking of the worksheet had excellent implementations.

D. Conclusion

The electronic-based worksheet could facilitate critical thinking skills about renewable energy. The trial test found most learners agreed and the obtained score was 0.93. Most learners also agreed with the critical thinking skill. The obtained mean is 1. The developed worksheet could facilitate the realization of the aspects of convenience, interest, content, and critical thinking. Based on the learning activity and practice, the worksheet could facilitate critical thinking skills, especially the analytical and evaluation indicators.

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