Developing an e-learning-based critical-thinking assessment as a physics learning evaluation media with *Kahoot!* interactive quiz

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**Abstract:** This study aimed to determine process, feasibility, validity, and reliability of the developed E-learning-based critical thinking assessment as a physics learning evaluation media with Kahoot!. The Research and Development method used was by Borg & Gall. The instrument used was a questionnaire. The type of data produced was quantitative data. The final product was declared feasible with the obtained score percentage of 85.89% by media experts, 80.50% by the material expert, and 94.93% by information and technology expert. The developed product was deemed attractive with the obtained attractiveness score percentages in the small-group trial of 86.10% and the field trial of 83.03%. The items of the product were reliable. The objective of this study was only to develop a physics learning evaluation product using Kahoot! and did not seek the influence of the use of the developed product. Therefore, for further research it can be found the effect of using the following products on student achievement. Based on the research results, the developed product in the form of an E-learning-based critical thinking assessment as a physics learning evaluation media with Kahoot! interactive quiz is said to be feasible and can be used to evaluate physics learning activities.

**Keywords:** Critical-Thinking, Kahoot, Physics Learning Evaluation Media

1. **Introduction**

The 21st-century competencies require students to take advantage of information and communication technology (ICT). This shows that ICT is certainly closely related to the learning resources or media used by students [1]. Currently, technology has been widely integrated into classrooms, such as mobile devices, computers, and software. Therefore, teachers can integrate various learning resources through applications and online platforms [2]. IT-based media generally offer something interesting. This is supported by the information that the latest curriculum integrates an IT-based learning system. However, a problem regarding the learning evaluation process often occurs. So far, the learning evaluation process tends to use printed media that make cheating possible so that the learning outcomes do not show a real understanding of students[3]. The assessment using printed media is a traditional method. Now, tests or exercises could be administered through interactive quizzes. Interactive quizzes also make it easier for teachers in the assessment process because the correction process does not need to be done manually[4].

A quiz can measure knowledge and skills [5]. Interactive quizzes are presented using computer illustrated questions and moving images. The type of quiz could be made innovative, namely the multiple response types [6]. The use of game-nuanced quizzes is a potential strategy in learning. De Macedo argues that doing quizzes while playing could increase the ability to acquire knowledge and...
stimulate reasoning [7]. Lee and Hammer also argue that taking quizzes while playing can motivate the players because it can affect their cognitive domain [8]. Game-based learning has the potential to be a learning tool that can stimulate visual and verbal components [9]. Interactive media used in teaching and learning activities is considered effective to give the impression of practical, positive, and enjoyable learning [10]. The availability of instructional and educational science-based interactive technology has encouraged collaborative and interactive learning activities [11]. In this case, teachers can take advantage of the use of an application to be used in learning and evaluation activities. One example of an interactive quiz application is Kahoot! [12].

Kahoot! is a response system or application in the form of an online classroom that is used to introduce and teach new concepts or assess the concept mastery [13]. Kahoot! has more than 30 million users worldwide [14]. It is a game-based application aimed to create and share tests or quizzes, increase self-confidence, enthusiasm, and participation of students during teaching and learning activities [15]. This free online tool enables the application of quick quizzes to assess students' knowledge in real-time [16]. Kahoot! is used to increase class participation, make learning interesting, and assess the cognitive level of students in the form of game-based quizzes. Teachers can choose videos and images to be attached to the questions to facilitate learning [17]. The types of quizzes available in Kahoot! are multiple-choices, true or false, puzzles, and others [18].

Quizzes on Kahoot! can be used in two settings, namely questions that are projected on a large screen where students answer the questions on their mobile devices and the questions are on students' mobile devices without being projected on the screen [19]. A 30 seconds time limit can be applied to each question where the correct answers will be given points [20]. As for the steps to use Kahoot! teachers should access https://Kahoot!.com to create an account. After that, the teachers determine the material to be delivered in learning activities. Then, the teachers create a group to direct students to use their android, notebook, or laptop devices. The students are directed to access https://Kahoot!.it. After the teacher has finished making the material, a multiple choices question will appear and be displayed on the teachers' devices [21]. With Kahoot! teachers can immediately find out how many questions students have answered correctly without having to check manually.

From the results of interviews in the pre-research with physics teachers at school, it was known that not all teachers designed learning evaluation instruments using online applications, and based on the questionnaire that has been given to students in the pre-research, it was known that they are feel bored and not interested when answering question with paper. They want a fun media for answering question in physics learning evaluation. Therefore, the learning evaluation tool using Kahoot! had been developed. In the development process, the researchers used a Likert scale to determine the feasibility and attractiveness of the product. The purposes of this development research were to determine the process, the feasibility, and the validity and reliability of the developed E-learning-based critical thinking assessment as a physics learning evaluation media with Kahoot! interactive quiz as well as to know students' responses toward the developed product. The difference between this study whith a similar study and also using Kahoot! is, this study designed Kahoot! as media for critical thinking assessment in physics learning, and no one has designed Kahoot! as media for critical thinking assessment in physics learning in previous studies. This study only develops learning evaluation product and different form previous studies, the previous studies looks for the effect of using the Kahoot! application on student achievement. The result of this study is, succeeded in making a physics learning evaluation using Kahoot! application. Based on the result of data calculations, this product was declared feasible and attractive for us as a physics learning evaluation media. The items of the product were also declared reliable.

2. Method

The Research and Development method was employed in this research by adopting the Borg and Gall development model. The development model describes the flow of procedures to produce or develop a product. The developed product of this research was a critical-thinking assessment as a medium for evaluating physics learning by using Kahoot! interactive quiz. The focused materials were work and
energy. This research aimed to determine the feasibility and attractiveness of the developed product as well as to determine the validity and reliability of the instruments. The indicators of critical-thinking consisted of drawing conclusions and explaining an event based on existing facts; determining the reasons; naming and classifying things into their categories; connecting similarities and differences in an activity; interpreting and explaining data tables, graphs, and diagrams; and evaluating, making decisions, and providing an assessment [22]. The following is the development procedure:

![Diagram of the Research Procedure](image)

**Figure 1.** The Research Procedure.

The first development step was to create a specification of questions and critical-thinking questions about work and energy materials that were relevant to the standard and basic competencies. The images attached to the product were made using the Photoshop application. Meanwhile, the animated videos were made using the Toon Boom Animation software. The produced videos were edited using the Kinemaster and inShot applications. After the pictures and videos for the questions had been made, they were inserted into the created questions in Kahoot!. The videos were first uploaded into YouTube and then the links of the videos were inserted into the questions. The number of questions in this critical thinking product using Kahoot! is 35 questions and types of quizzes available in Kahoot! are multiple-choices. The followings are the sample images attached to the questions:

![Sample Image 1](image)

**Figure 2.** The Sample of Image.

![Sample Image 2](image)

**Figure 3.** The Sample of Image.

There were two trials in this study, namely a small-group trial with 10 students of each school as the respondents and a field trial. The research was conducted at three schools, namely SMAN 15 Bandar Lampung, SMAN 17 Bandar Lampung, SMAN 1 Tanjung Bintang with 25 students who were taken from each school as the respondents. The data collection was carried out by distributing questionnaires to the validators, namely the media experts, material experts and, information and technology (IT) experts. Also, a questionnaire was distributed to students. Validation and questionnaire activities aimed
to find out the feasibility and attractiveness of the developed product. To calculate the feasibility percentage, the following formula was used [23]:

\[ p = \frac{f}{N} \times 100\% \]

Explanation:
P: The percentage of feasibility
\( f \): The obtained score
\( N \): Total maximum score

The resulting scores of the validation questionnaire were interpreted using the criteria that is shown in table 1 [24]:

| Interval Score | Criteria          |
|----------------|-------------------|
| 0-20%          | Poorly Feasible   |
| 21-40%         | Not Feasible      |
| 41-60%         | Fairly Feasible   |
| 61-80%         | Feasible          |
| 81-100%        | Highly Feasible   |

To calculate the percentage of attractiveness, the following formula was used [25]:

\[ p = \frac{f}{N} \times 100\% \]

Explanation:
P: The percentage of attractiveness
\( f \): The obtained score
\( N \): Total maximum score

The next step was to interpret the obtained scores based on the criteria of attractiveness that is shown in table 2 [26]:

| Interval Score | Criteria          |
|----------------|-------------------|
| 0-20%          | Very Unattractive |
| 21-40%         | Unattractive      |
| 41-60%         | Quite Attractive  |
| 61-80%         | Attractive        |
| 81-100%        | Very Attractive   |

3. Result and Discussion

3.1 Experts Validation

The validation percentages had been obtained based on the experts’ responses to the validation stage. The validation percentages obtained from the media experts, the material experts, and the IT experts
were 85.89%, 80.50%, and 94.93% respectively. The results indicated that the developed product possessed high feasibility and can be used in the teaching and learning processes.

Several aspects were assessed regarding the quality of the product, namely the quality of content, language, ease of use, presentation, and content or material standards. The results obtained stated that the developed product is appropriate to be used based on various inputs and suggestions from the experts.

3.2 Students’ Responses
The next data was obtained from the small-group trial and the field-trial to determine the attractiveness of the developed product. Based on the results of the small-group trial, the percentage of attractiveness was 86.10% which indicated that the developed product was very interesting. Furthermore, the results of the field trial were 83.03% which also indicated that the developed product was very interesting. Based on the percentages of attractiveness, the developed product can be said as attractive and suitable to be used to evaluate physics learning. The following figures represent the students’ responses regarding the attractiveness of the developed product in the small-group trial and field trial.
The next step was to analyze the items contained in the evaluation instrument to determine the validity, reliability, discrimination index, and difficulty level. The items consisted of 35 questions on work and energy material. After the analysis had been performed, it was found that the instrument was reliable and valid.

Based on the research data and analysis, the developed product deemed appropriate and attractive to be used as a media for evaluating physics learning so that the learning evaluation activities can be more interactive and fun. This is supported by similar previous research conducted by Kristie, Cameron, and Lewis in 2019. The study aimed to assess student opinions of Kahoot! and attempt to identify a direct relationship between the use of Kahoot! and the students’ final grades. Which discovered that Kahoot! provides a fun learning as a social learning technology and leads to students’ involvement and participation, and also Kahoot! has an impact on students’ final grades. This study proves that Kahoot! has an impact on increasing students’ understanding [27]. Then the research conducted by Dominik Dolezal, Alexandra Posekany, Renate Motschnig, and Robert Pucher in 2018. The study aimed to find out the effect of using Kahoot! on students’ motivation. Which discovered that Kahoot! gives a higher learning effect and makes engineering students more motivated and satisfied with the quizzes presented. This study proves that Kahoot! increases students’ motivation in learning. Activity [28]. The difference between this study with a similar study and also using Kahoot! is this study did not investigate the influence or impact of the product on students’ learning outcomes and understanding. This study designed Kahoot! as media for critical thinking assessment in physics learning, and no one has designed Kahoot! as media for critical thinking assessment in physics learning in previous studies. The result of this study is succeeded in making a physics learning evaluation using Kahoot! application. Based on the result of data calculations, this product was declared feasible and attractive. The items of the product were also declared reliable.

The developed product presents several advantages, namely, it is practical to use and can make learning evaluation activities fun, increases students’ participation and enthusiasm, can make the classroom atmosphere more interactive, can assess the knowledge or cognitive level of students in real-time, and can support the development of cognitive, motivational, and emotional views of students. Physics evaluation media using Kahoot! is suitable to be used in a face-to-face classroom setting or online learning. The Kahoot! application provides a feature to insert images and videos into questions so that the questions given are interactive and varied. With Kahoot! teachers can immediately find out how many questions students have answered correctly without having to check manually.

4. Conclusion
The product of this development research was the E-learning-based critical thinking assessment as a physics learning evaluation media with Kahoot! interactive quiz. It was highly feasible and can be used
as a medium for evaluating physics learning based on the assessments of several experts, namely media experts, material experts, and IT experts. The results of attractiveness assessment in the small-group trial and field trial indicated that the developed product was very attractive. The developed product was also reliable and valid based on the analysis in the small-group trial and field trial. In conclusion, the E-learning-based critical thinking assessment as a physics learning evaluation media with Kahoot! An interactive quiz was feasible and can be used to facilitate physics learning evaluation activities. This study did not investigate the influence or impact of the product on students’ learning outcomes and understanding. Therefore, for further research it can be found the effect of using the following products on student achievement. To make videos and images that will be included in the questions, the teacher must have additional skills to use other applications such as Photoshop and Toonboom animation to get good images and videos.

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