

Analysis of the Development Needs for Interactive Web-Based E-book on Pressure Topic for Differentiated Science Learning

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Received: 1 December 2022; Accepted: 07 April 2023; Published: 17 May 2023

DOI: <https://dx.doi.org/10.29303/jpft.v9i1.4441>

Abstract – This research aims to describe the needs analysis results conducted at SMP Negeri 19 Singkawang as the basis for developing web-based interactive e-book teaching materials on pressure for differentiated science learning. This study is a Research and Development study. The researcher employed a qualitative descriptive research method. Data collection techniques included non-test instruments such as questionnaires, interviews, observations, and documentation. Data analysis was conducted using a qualitative approach. The development of web-based interactive e-books utilized the 4D development model, consisting of four stages: define, design, develop, and disseminate. This study served as a preliminary study in the define stage, where the researcher ensured that the developed product would meet the needs of teachers and students. Based on the findings, students highly demanded web-based interactive e-book media for the topic of pressure. The researcher concluded that students require engaging, interactive teaching materials that can be easily accessed through their frequently used smartphones and contain diverse content with various media formats that cater to their learning styles. Teachers require interactive e-books to enhance the quality of science teaching on the topic of pressure. Differentiated science learning strategies integrated into interactive e-book are necessary for teachers to provide appropriate teaching materials and media that meet the student's learning needs. The availability of supporting facilities and adequate internet connection allows the utilization of web-based interactive e-books on the topic of pressure by students at SMP Negeri 19 Singkawang.

Keywords: Interactive E-book; Differentiated Science Learning; Pressure

INTRODUCTION

Effective and high-quality learning is a teaching and learning activity that considers learning components such as learning experiences or curriculum, teaching materials, and media, where the students' learning goals are successfully achieved. However, obstacles in achieving the learning goals still often occur, mainly due to monotonous and less interactive teaching activities, inadequate teaching materials and media support, and the limited use of technology that can facilitate the learning process in the current digital era. According to Kohlberg (Aunurrahman, 2019), understanding students is one of the essential components of learning. By understanding students' development, teachers can determine learning materials that align with

the current era to create an effective learning process.

Implementing science learning in each educational unit should be conducted fun, interactive, and challenging to stimulate students' motivation for active engagement, considering their physical, interests, and psychological development (Fitria, 2019). However, teachers still need help implementing the desired science learning. Science education involves abstract concepts that often lead students to develop misconceptions and encounter difficulties in understanding the concepts. Consequently, this affects their overall comprehension of the learning materials. (Feri & Zulherman, 2021).

Science learning involves three branches of science: physics, chemistry, and

biology at the junior high school level. Physics is often perceived as the most difficult concept by most students compared to biology and chemistry. According to science teachers, this is due to the abundance of formulas, abstract concepts, and language that are often difficult for students to comprehend.

Moreover, physics learning also requires a strong understanding of basic mathematical concepts. Based on observations at SMP Negeri 19 Singkawang, the utilization of the internet and websites for science learning is still limited, there are no interactive electronic books as learning resources, and the use of mobile phones for learning needs to be well-directed. It means that learning materials and interactive media that cater to diverse learning needs have yet to be made available.

According to Marcei Nordlund (2003), a learning strategy that considers the diverse needs of students is called differentiated learning. Differentiated learning is a learning process based on student's individual needs, including their readiness, profiles, and interests (Fitra, 2022). In the current implementation of the independent curriculum, educators are expected to implement differentiated learning. SMP Negeri 19 Singkawang is one of the educational units that has implemented the independent curriculum. Based on interviews, differentiated science learning still needs to be optimally implemented at the school. The current science learning process still needs to consider students' learning needs. Research results (Herwina, 2021), state that differentiated learning can help students achieve optimal learning outcomes because the presented content can be adjusted to their interests.

Based on the reality mentioned above, the researcher initiated the development of teaching materials and learning media that

support differentiated science learning through interactive e-book. The development plan for interactive e-book is carried out using the 4-D development design by Thiagarajan, consisting of the define, design, develop, and disseminate stages (Maydiantoro, 2021). In this research, the researcher only conducted the define stage, which involved a preliminary study describing the needs analysis of the interactive e-book product to be developed.

In developing e-book, innovation is needed to make them attractive and interactive for students (Rusli et al., 2017). Interactive e-books present various media elements such as text, audio, animation, images, and videos that support a contextual understanding of the material (Rachmadiarti, 2020). The advantage of e-books as teaching materials is their ease of access anytime and anywhere (Alwan, 2018) and they can be designed to meet the diverse learning needs of students (Pratama, 2022). The research by Margareta (2021) found that the use of interactive teaching materials has a significant positive impact on improving the understanding of the material, with a gain score reaching 0.72 (high category). Based on previous research and field surveys, the researcher initiated the design of a web-based interactive e-book as a teaching resource for science, specifically on the topic of pressure, using differentiated learning strategies.

RESEARCH METHODS

This research employs a qualitative descriptive method. This study describes the results of a preliminary study, which involves analyzing the needs of students in implementing the 4D development model for designing web-based interactive ebook teaching materials for differentiated science learning at the junior high school level. The research subjects consist of 64 students from

Grade VIII and two science teachers at SMP Negeri 19 Singkawang. Data collection for this research utilizes non-test instruments. Non-test techniques are used to obtain specific data from respondents, not in the form of right or wrong answers (Kurniawan, 2018). The data collection techniques include questionnaires, unstructured interviews, observations, and documentation. The data analysis technique adopts a qualitative approach.

The preliminary study consists of two stages: field study and literature review. The field study activities involve classroom observation, documentation of learning outcomes, analysis of lesson plans and students' learning styles, interviews with science teachers, and administering questionnaires to Grade VIII students. Furthermore, the researcher conducts a literature review regarding the development plan for web-based interactive e-book teaching materials, including theoretical studies, previous research, and design information.

The questionnaire used in this study is adapted from the research findings of Rodiah dan Roza (2020) in the national seminar on physics education at FITK UNSIG (Rodhiah & Roza, 2020) and has been validated by experts. The questionnaire's purpose is to determine whether students require interactive e-book teaching materials and assess the suitability of the developed teaching materials for the student's classroom conditions. Classroom observations are conducted to understand the usual teaching process, teaching materials and media used, and the school's facilities. Interviews are necessary to ascertain the extent of ICT utilization in science education and the teacher's needs in the teaching process. To assess students' learning outcomes, analyze lesson plans, and understand students' learning styles, the

researcher requires documentation. Information on students' learning styles is obtained from the guidance and counselling (BK) teacher's documents, which already contain data on the learning styles of Grade VIII students using a validated learning style questionnaire.

RESULTS AND DISCUSSION

Results

Based on the documentation results at SMP Negeri 19 Singkawang, the topic with the lowest average learning outcomes for Grade VIII science is pressure, with a score of 48. The criteria for achieving class proficiency is a score higher than 75%. The criteria for individual proficiency is achieved if the score is $\geq 70\%$. Regarding proficiency in the pressure topic, only 25% of students reached the class proficiency level, as detailed in the following table.

Table 1. Student Learning Proficiency in the Pressure Topic

Category	Individual completeness		Total
	Complete	Not Complete	
Frequency	16	48	64

Based on the observations and documentation results, students in classes VIIIA and VIIIB exhibit diverse learning styles, as depicted in the following figure, which presents the percentage distribution of students.

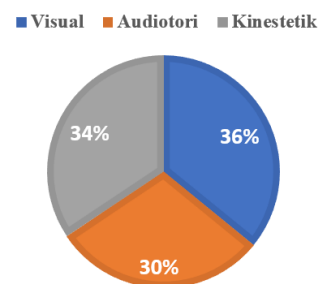


Figure 1. Percentage of Student Learning Style

The researcher administered the questionnaire to the students online using Google Forms. Before distributing the questionnaire, the researcher could enter the classroom and present one widely circulated interactive ebook example for a different subject to the students. The purpose was to provide the students with an understanding of the teaching materials addressed in the questionnaire. The questionnaire results (needs analysis) provided to the 64 Grade VIII students are described in several questions and diagrams, as detailed below.

- 1) The students were asked the question, "Do you have any reference books or other learning resources apart from the textbooks provided at school?" Based on the collected data from the needs analysis, it was found that 76.6% of students (49 out of 64) do not have any additional learning resources.

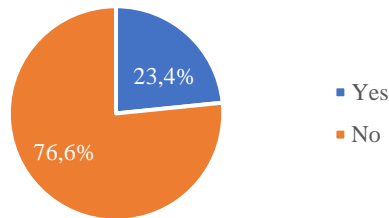


Figure 2. Student's responses about having the other learning resources

- 2) The students were asked the question, "Do you often use a smartphone for studying?" Based on the collected data from the needs analysis, it was found that 62.5% of students (40 out of 64) frequently use their smartphones to aid in their studying.

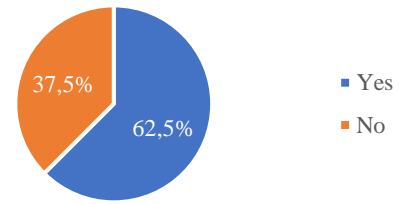


Figure 3. How often students use the mobile phone to study

- 3) The students were asked the question, "Do you need additional learning resources apart from the textbooks provided at school?" Based on the collected data from the needs analysis, it was found that 71.9% of students (46 out of 64) require additional learning resources.

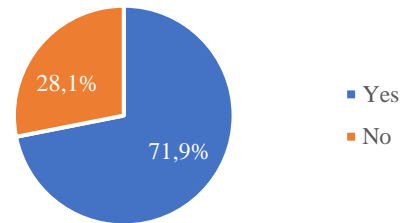


Figure 4. Students require additional learning resources

- 4) The students were asked the question, "Do you have a cellphone to use for learning science at school?" Based on the collected data from the needs analysis, it was found that 90.6% of students (58 out of 64) have a cellphone that they can use for learning science at school.

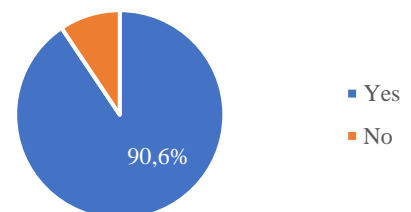


Figure 5. Students have a cellphone

5) The students were asked the question, "Is there someone who accompanies or assists you when studying at home?" Based on the collected data from the needs analysis, it was found that 84.4% of students (54 out of 64) do not have anyone to accompany them while studying at home.

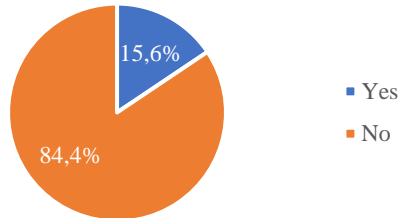


Figure 6. Students have someone who assists at home

6) The students were asked the question, "Have you ever used an e-book to study science?" Based on the data collected for the needs analysis, 84.4% of the students (54 out of 64 individuals) have not used an e-book for studying science.

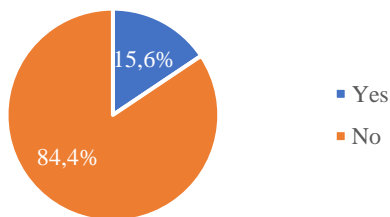


Figure 7. Students never used e-book

7) Students were asked the question, 'Do you need interactive e-book as learning materials for studying Science?' Based on the collected data and analysis of needs, 95.3% of students (61 out of 64) expressed the need for interactive e-book.

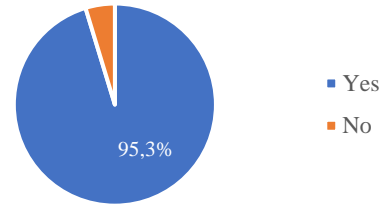


Figure 8. Students need interactive e-book

8) Students were asked, 'Do interactive web-based ebooks for learning Science match your interests and learning styles?' Based on the collected data and needs analysis, 71.9% of students (46 out of 64) stated that interactive ebooks align with their interests and learning styles.

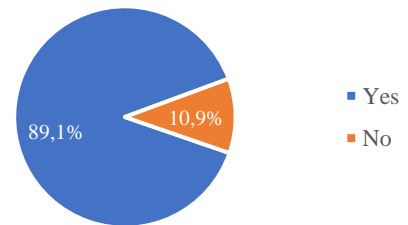


Figure 9. Interactive E-book aligns with the interests and learning styles of the students

9) Students were asked about the preferred types of media in the interactive e-book that align with their interests and needs. Based on the data collected in the needs analysis, 46.6% (30 out of 64) of students indicated a need for videos, 31.3% (20 out of 64) expressed a need for images/photos, and 14.4% (9 out of 64) mentioned a need for engaging reading materials.

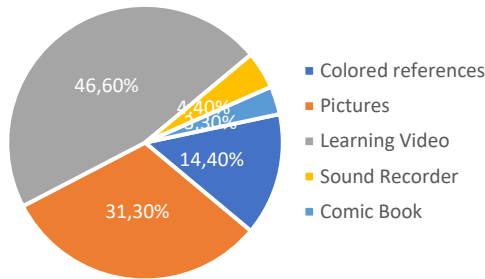


Figure 10. The types of media that align with students' interests and needs

10) Students were asked, 'Are you interested if the interactive e-book includes online quizzes or games for learning?' Based on the data collected for needs analysis, 59.5% (38 out of 64 students) showed interest in having online quizzes or games in the interactive e-book.

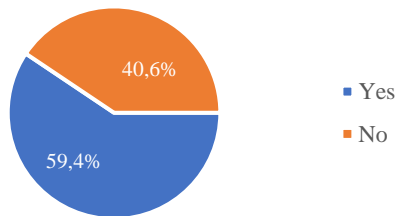


Figure 11. Students agree to have online quizzes and games in the interactive e-book

11) The students do not experience any difficulties if the interactive e-book is used in the classroom, according to the needs analysis data, with 71.9% agreement (46 out of 64 students).

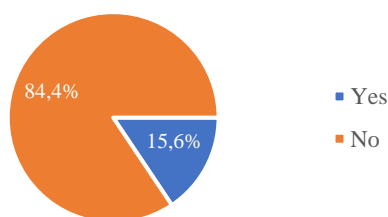


Figure 12. The students do not experience any difficulties using interactive e-book

12) The students were asked about any difficulties they experienced in the classroom when using the interactive e-book. Based on the questionnaire data, students who encountered challenges were estimated to be due to lack of focus and network connectivity.

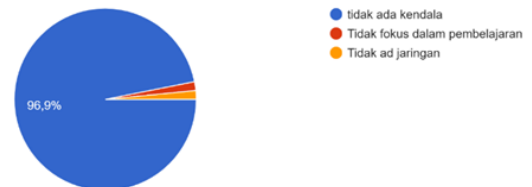


Figure 13. Possible challenges that may arise when using interactive e-book in the classroom

Based on the observation results of 64 participants, 70.3% of students consider science to be of moderate difficulty, 21.9% find it difficult, and 7.8% find it easy. External factors that contribute to the difficulty of science include the characteristics of mathematical calculations (57.8%), dense memorization material (12.5%), and difficulty in understanding the material due to a lack of learning media (12.5%). Internal factors among students include a lack of self-confidence in their abilities (59.4%) and a mismatch with the students' interests (17.2%).

Discussion

Based on the observations and documentation, students in grade VIII have diverse learning styles, including visual, auditory, and kinesthetic learning styles. Learning media that support the learning process and cater to diverse learning styles are essential components (Mulbar et al., 2018). Teachers require instructional materials that can also serve as learning media with varied content. An interactive web-based e-book on the topic of pressure is highly needed. The low achievement of

students in learning the concept of pressure can be attributed to several factors, such as a lack of simple practices that can be done at home, a lack of examples of pressure application in daily life, and a lack of engaging and interactive media that motivate students to learn independently.

Based on the data from the needs analysis questionnaire, most students possess and are accustomed to using mobile phones, but their use for supporting independent learning needs to be revised. Students require instructional materials in the form of interactive e-books that are engaging, aligned with their interests and learning styles, and easy to use, thereby supporting self-directed learning. Any material can be considered instructional if it is systematically arranged and enables students to learn independently (Magdalena et al., 2020).

The commonly used model is the scientific-based approach, specifically discovery learning, but it has yet to incorporate differentiated learning strategies. Additionally, lecture methods accompanied by discussions and games are occasionally employed to prevent students from becoming bored and to maintain their enthusiasm for learning. Learning science needs to be supported by interactive and multimedia learning media. In this regard, researchers need to consider the steps of scientific-based learning in developing interactive e-books. Moreover, teachers should incorporate more interactive gaming elements. The advantage of digital instructional materials with multimedia is that they can actively engage students, making the learning process more interesting and encouraging their active involvement (Kosasih, 2021).

Students often use mobile phones for learning purposes; however, they need direction and documentation since teachers

allow students to search for online learning resources without specifying the websites to use. In the digital era, students can utilize information technology to access additional instructional materials (Daryanto, 2013). In this context, developing web-based interactive e-books becomes increasingly necessary to provide more focused and practical learning using smartphones.

Interactive e-books are currently unavailable and have not been used in science education. Teachers believe that web-based interactive e-books are crucial for science education as they acknowledge the need to cater to the diverse needs of students. E-book can serve as learning resources and instructional media (Wazi'atus, 2022). Additionally, teachers require a section in the e-book that facilitates interactive reflection activities, which are time-efficient and yield easily obtainable results.

Several factors contribute to students' low achievement in the topic of pressure, such as a lack of simple activities that can be conducted at home, insufficient examples of pressure concept application in daily life, and a lack of appealing and interactive media that motivate students to learn independently. Therefore, the development of interactive e-books for the topic of pressure is necessary. Instructional materials equipped with simple experiments as a guide for self-directed learning can enhance students' learning outcomes on the topic of pressure (UM Metro & Rosa, 2015).

Based on the discussions, the researcher believes that teachers and students at SMP Negeri 19 Singkawang can utilize the developed e-book as they possess adequate electronic devices and internet facilities. Moreover, the researcher emphasizes the need to develop instructional materials in the form of e-books that incorporate various features, such as combining presentation media, text, audio,

images, videos, animations, and other interactive elements. It will facilitate teachers in implementing differentiated instruction, which is expected to enhance students' motivation and interest in self-directed learning. Furthermore, developing web-based e-books is necessary to ensure a more focused and practical learning experience for students and teachers. The e-book should include worksheets for students to perform simple, contextualized experiments on the topic of pressure that can be conducted at home. Additionally, interactive games or quizzes and reflection features are needed to make the learning process more engaging and to allow teachers to easily and systematically evaluate their teaching.

Several relevant previous studies support the development of web-based interactive e-books. Firstly, the research conducted by (Asi et al., 2022) states that the developed interactive ebooks must be valid and receive positive responses from both teachers and students to be effectively used in science education. Secondly, the study by (Siregar et al., 2021) indicates that the developed electronic book can significantly enhance creative thinking abilities. Lastly, (Ambarwati et al., 2019) found that interactive ebooks can significantly improve students' critical thinking skills. The findings from this preliminary study serve as a basis for analyzing the needs and further developing interactive ebook media, specifically on the topic of pressure, using differentiated science teaching strategies.

CONCLUSION

Based on the findings and discussions in this preliminary study, the researcher concludes that using web-based interactive ebooks as instructional materials for the topic of pressure is highly needed as a source of learning and as a supportive media for

science education. Furthermore, integrating differentiated science teaching strategies within the ebook is also necessary to enable teachers to provide instructional materials that meet the learning needs of students. The web-based interactive ebook instructional materials can be utilized by both students and teachers at SMP Negeri 19 Singkawang due to their possession of electronic devices and adequate internet access. Implementing the findings from this preliminary study can be used as a needs analysis for developing web-based interactive ebook instructional materials for the topic of pressure.

As for recommendations for future development research, it is suggested to assess the feasibility and practicality of using web-based interactive ebook instructional materials and examine the impact of their implementation. It would enable the assessment of the contribution and usefulness of the instructional materials on a larger scale.

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