Developing Electronic Student Worksheet Using 3D Professional Pageflip Based on Scientific Literacy on Sound Wave Material

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Abstract. This study aims to determine the feasibility of electronic student worksheet learning media with 3D Pageflip Professional based on scientific literacy through the results of expert validation and study the students' responses toward the developed media. This research is a development research by employing Research and Development method (R & D), specifically the ADDIE model. The subject of the research consisted of experts (content material experts and media experts) and the students of the eleventh grade of senior high school. The results of the expert validation reveal that the developed media belongs to the feasible category with a percentage of 86% from the content material experts and 94% from the media experts. The teachers and students respond positively to the attractiveness of the developed media as a medium of learning with a percentage of 89% from the teachers, 86% from the small-group trial, and 85% from the field trial. Thus, the developed media is categorized as attractive. The electronic student worksheet learning media with 3D Pageflip Professional based on scientific literacy on sound waves is highly feasible and obtains positive response to serve as a medium of learning.

1. Introduction
In the globalization era, human life is influenced by the development of science and technology. Many problems are arising in everyday life to complete the necessary scientific information. Science, in general terms, systematically relates knowledge of the structure of natural phenomena [1].

The drastic development of science in the 21st-century requires the teachers to work hard in adjusting all aspects of life. One way to address the obstacles in the 21st-century is science literacy [2]. Science literacy is the ability to creatively utilize the proper science to everyday life with scientific evidence and skills in solving problems [3]. Science literacy is one of the skills that can provide knowledge to solve students' everyday life problems. Scientific literacy is distinguished into four dimensions called the content (knowledge of science), process (competence of science), context (science applications), and cognitive (attitude) [4].

Science literacy is significant enough to get the attention of the Organization for Economic Co-operation and Development (OECD) which appoints PISA as one of a comparative study to determine
the extent of knowledge on students' scientific literacy, specifically the 15 years old students. The results of the PISA studies suggest that the level of science literacy in Indonesia is still low and below the OECD average. The latest measured science literacy was in 2015 which revealed that the average score of Indonesian students' science literacy is 403 [5].

The world of education has entered the era of technology where the use of electronic media as a tool in the learning process if it is appropriately used, can affect the quality of teaching and learning in class [6]. According to the Department of National Education, if the teachers can develop and use instructional media well, it means that they have acquired a learning media that is in line with the demands of the curriculum, even more, it could also correspond to the students' needs [4].

A student worksheet is one medium that can be used in the learning process and can also support the learning process. A student worksheet is a learning tool that can be used in exploring the learning process and can create active students [7]. Learning media in the form of electronic student worksheet is intended to optimize the teaching and learning activities. So far, student worksheet is known as printed teaching material. The student worksheet can be presented in the electronic form. It will become interactive by not only presenting the material, but it is also equipped with video and pictures that can improve or reinforce students' understanding in learning the material [8]. To support the physics learning, electronic student worksheet learning media with 3D Pageflip Professional can be used as an alternative to facilitate physics learning [9].

Several requirements must be met in developing a student worksheet, namely [10]:

1. **Didactic**
   Didactic means the student worksheet should follow the principles of effective teaching, namely:
   a) Noting the existence of individual differences so that it can be used by all students who have different abilities. It can be used by low, medium, and high-achieving students.
   b) Emphasizing on the process to find concepts that serve as a guide for students to search for information instead of providing information.
   c) Having a variety of stimulus through various media and activities to provide an opportunity for students to write, experiment, practice, and others.
   d) Developing communication skills that cover the emotional, social, moral, and aesthetic of students so it not only presents facts and academic concepts but also social skills and psychological.
   e) The students learning experience is determined by the purpose of the students' personal development, not by learning materials.

2. **Construction**
   Construction relates to the use of language, sentence structure, vocabulary, level of difficulty, and clarity. It covers:
   a. Using appropriate language based on students' level of maturity,
   b. Using a clear sentence structure,
   c. Constructing the lesson according to the students' levels of ability. It means that the development of the student worksheet must start from the simple things toward something more complex,
   d. Avoiding too broad questions,
   e. Referring to the standard books of students' ability limitation,
   f. Providing sufficient spaces for the students to write and describe things that they want to convey,
   g. Using illustration more than words,
   h. Can be used by slow-paced and fast-paced students,
   i. Having a clear purpose and benefits of learning,
   j. Providing identity for easier administration.

3. **Technical**
A student worksheet can be classified in the good category if it is technically qualified in terms of:

a. **Written Material**
   - The written material must consider the following aspects:
     1. Using capital letters and not using Latin letters/roman,
     2. Using rather large bold letters on the topic,
     3. Using a frame to distinguish the instructions and students' answers,
     4. Using an appropriate range between letters and images.

b. **Image**
   - A good image can deliver messages to users.

c. **Appearance**
   - The appearances should be made attractive to become the center of attention in studying.

The 3D Pageflip Professional can be used to create a digital student worksheet with 3D effects. This application provides a very attractive appearance. This application can change PDF, video, picture files into astonishing 3D flash images with a variety of formats. 3D Pageflip Professional software is used to create teaching materials with 3D effects and complete navigation so that the page-turning effect will feel more real [11].

Sound waves are the materials focused on this study. Researchers chose sound waves as research material based on the consideration that the application of sound waves in everyday life is very real and can be easily investigated. The researchers only took sound waves as a research topic to focus on science literacy learning so that the research can be properly focused and accurate. Also, in the measurement of scientific literacy, the researchers constructed the instruments based on 3 cognitive domains of science literacy.

Preliminary research was conducted at three schools by employing a Likert scale questionnaire and test to students. An interview was conducted with the physics teachers. It was obtained that, based on the questionnaire and interviews in SMAN 9 Bandar Lampung, the school is already using the 2013 curriculum and no one has ever used the media related to science literacy. They use learning media in the form of a printed book provided by the school and should be used in turn with other classes. Based on the result of the test given to the student, 81.25% of students scored below the minimum criteria and cannot answer the questions. There were only 18, 75% of students can answer the questions and score above the minimum criteria.

Based on the questionnaire and interviews conducted to the physics teachers at SMAN 13 Bandar Lampung, it is known that the school already uses the 2013 curriculum and no one has ever used the media related to science literacy. They use learning media in the form of a printed book that is hard to understand which causes the students to lose their enthusiasm in learning because it is presented unattractively. Based on the results of the test given to the students, 100% of students scored below the minimum criteria and cannot answer the questions. No students can answer the questions and score above the minimum criteria.

Based on the questionnaire and interviews conducted to the physics teachers at MAS (Private Islamic High School) Diniyyah Putri Lampung, it is known that the school is already implementing the 2013 curriculum and no one has ever used the media related to the science literacy. They use learning media in the form of a printed book that is hard to understand which causes the students to lose their enthusiasm in learning because it is presented unattractively. Based on the test given to the students, 85.71% of students scored below the minimum criteria and cannot answer the questions. There were 14.28% of students who can answer the questions and score above the minimum criteria.

Given the circumstances, media that can encourage students in the process of learning physics and introduce the science literacy in learning physics is needed so that the students have high scientific literacy and become active citizens in facing rapid development [4].

The professionally unsupported instructional media in all aspects of science literacy make it difficult for the students to understand and comprehend the physics learning individually. Thus, a learning media that is easy to obtain is needed. Thus, a non-printed media, such as an Electronic student worksheet, is needed [3]. Electronic student worksheets can display simulations by combining...
text, animation, video, images, and navigation so that learning takes place interestingly and can optimize the learning process.

Based on the explanation, the researchers intended to develop learning media in the form of electronic student worksheet learning media with 3D Pageflip Professional based on scientific literacy that can optimize the physics learning process. To answer the need, the researchers conducted research entitled development of electronic student worksheet learning media with 3D Pageflip Professional based on scientific literacy on sound waves material.

2. Research Method
This development research used Research and Development (R & D) method. The developed product is electronic student worksheet learning media with 3D Pageflip Professional based on scientific literacy on sound waves material for the eleventh-grade senior high school students. The model used is ADDIE (Analyze, Design, Development, Implementation, and Evaluation) [12].

The data was collected by using validation sheets given to the materials experts and media experts as well as the students' responses. Data analysis was performed to obtain the feasibility after being revised. The test instrument used was a Likert Scale questionnaire to measure attitudes, opinions, and perceptions of a person or a group of social phenomenon [13]. In this study, a scale ranged from 1 to 5 was used; with 5 as the highest score and 1 as the lowest score. Then, the percentage of validation was calculated. The criteria can be seen in the following table.

| Criteria                | Interval         |
|-------------------------|------------------|
| Highly Not Feasible     | 0 < X ≤ 20%     |
| Not Feasible            | 20 < X ≤ 40%    |
| Moderately Feasible     | 40 < X ≤ 60%    |
| Feasible                | 60 < X ≤ 80%    |
| Highly Feasible         | 80 < X ≤ 100%   |

3. Result and Discussion
This preliminary research was done by observing the school and at the same time interviewed the teachers. A questionnaire and a test were given to the students. The purpose of this preliminary research was to obtain initial data of preliminary analysis. Interviews were conducted to the teachers to determine the curriculum used at the school. The curriculum used at SMAN 9 Bandar Lampung, SMAN 13 Bandar Lampung, and MAS Diniyyah Putri Lampung was the 2013 curriculum. Media analysis was conducted to determine the media used by teachers for the classroom learning process. The learning media used in school was printed media that is considered less attractive and caused the students to be passive during the learning. Unattractive learning caused the students to be lazy in learning and lack of science literacy knowledge.

Based on observation, learning media used by teachers were suboptimal although the learning process had already been supported by an LCD/projector and computers so that the learning process in class became boring and most students thought that physics is a difficult subject.

The researchers developed an electronic student worksheet learning media with 3D Pageflip Professional based on scientific literacy on Sound Wave Material that is attractively packaged and can be used by students for classroom learning. After analyzing the needs, the next step is the design stage. The developed media is an electronic student worksheet that can help teachers and students in learning. The media is equipped with learning materials. Also, the researchers developed the electronic student worksheet using a 3D Pageflip professional that supports text, images, sound, video, simulations, and 3D effects that helps the students to focus on the physics learning material.
Based on the analysis, the researchers developed an electronic student worksheet learning media with 3D Pageflip Professional based on scientific literacy on sound waves material that is attractively packaged to improve students’ enthusiasm and provides the physics knowledge related to the daily lives.

Once the product was successfully developed, the next stage of development was the feasibility testing stages conducted by a team of experts as the validator. The team consisted of 5 experts, specifically two material experts and three media experts.

The results of validation from the material experts revealed that the electronic student worksheet learning media with 3D Pageflip Professional based on scientific literacy obtained a percentage of 73% before the revision and 86% after the revision which indicated that the developed media belonged to the highly feasible category in term of content quality, accuracy, and materials and exercises updates. The detail of the validation results based on the material experts can be seen in Figure 1.

![Figure 1. The Results of Material Expert Validation](image)

The results of validation from the media experts revealed that the electronic student worksheet learning media with 3D Pageflip Professional based on scientific literacy obtained a percentage of 83% before the revision and 94% after the revision which indicated that the developed media belonged to the highly feasible category in term of display, attractiveness, ease of use. The detail of the validation results based on the media experts can be seen in Figure 2.

![Figure 2. The Results of Media Expert Validation](image)

After going through the validation by the experts, then the developed media was tested to teachers and students to see their responses. The percentage of physics teachers' responses is 89% with a very
attractive category in terms of media display, the attractiveness of the media, ease of use, and science literacy aspects. The details can be seen in figure 3.

A small-group trial was conducted to 30 students in three schools, SMA Negeri 9 Bandar Lampung, SMAN 13 Bandar Lampung, and MAS Diniyyah Putri Lampung. The percentage obtained was 86% which belonged to the good category (attractive) in terms of display, the attractiveness of the media, ease of use, and science literacy aspects. The details of the percentage of the small-group trial can be seen in Table 2.

| Aspects                       | Percentage (%) |
|-------------------------------|----------------|
| Display                       | 83%            |
| The Attractiveness Of The Media | 88%            |
| Ease Of Use                   | 85%            |
| Science Literacy Aspects      | 87%            |
| **Average**                   | **86%**        |

Furthermore, the results of a field trial conducted to 72 students at the same schools obtained a percentage of 85% with an excellent category in terms of display, the attractiveness of the media, ease of use, science literacy aspects. The students’ responses toward the developed media were well and enthusiastic. These results indicate that the electronic student worksheet learning media with 3D Pageflip Professional based on scientific literacy was well received by the students to be used as a medium for learning activities in class. The details of the field trial’s results can be seen in graph 4.
After getting the responses from the teachers and the students, more evaluation as a form of revision was done. It can be said that the electronic student worksheet learning media with 3D Pageflip Professional based on scientific literacy has been developed to be the final product.

4. Conclusion
By using ADDIE (Analyze, Design, Development, Implementation, and Evaluation) model on the research and development steps, the electronic student worksheet learning media with 3D Pageflip Professional based on scientific literacy on sound waves material has been successfully developed. Based on the results of the material experts’ validations, an average percentage of 86% was obtained and an average percentage of 94% was obtained through the media experts’ validation. The average percentage obtained from the physics teachers was 89% and the average percentage obtained from the small-group trial was 86%, and the average percentage obtained from the field trial was 85% which belonged to the excellent category.

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