E-Book Static Fluid and Dynamic Fluid Web-Based with a Problem-Based Learning Model to Improve Students Physics Problem-Solving Skills

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Abstract. This study aims to develop physics learning media in the form of a static fluid and dynamic fluids e-book based on website with Problem Based Learning for students learning. The research subjects were 43 5th semester student of Jakarta State University. The research method used is Research and Development (R&D) research using the ADDIE development model (Analysis, Design, Development, Implementation, and Evaluation). The result of the instrument validation showed 90.31% for the validation of media experts, 94.94% for the validation of material experts, and 77.09% for the validation of learning experts. Based on the results of the validation of media experts, the material, and learning can show that this e-book in terms of several indicators used for validations has very decent criteria. Based on the result of trials to students, the results obtained an average score of all aspects of 88.39% with a very feasible interpretation and the impact on students Physics Problem Solving was measured. Based on the result of the effectiveness test show that there are differences in physics problem solving among students who use static fluids and dynamic fluids e-book based on Problem Based Learning and static fluids and dynamic fluids e-book based on Non-Problem Based Learning. Based on the D’Cohens test, the use of static fluids and dynamic fluids e-book based on Problem Based Learning made an effective contribution to increasing students Physics Problem Solving by 2.51 in the medium category, so it can be concluded that the developed e-book can increase the Physics Problem Solving students.

1. Introduction
Considering the rapid technological advance of the Internet in particular has brought benefits and a powerful influence to everyone connected with education. With these benefits, it is also helpful in curriculum 13 that emphasizes technology-based learning in accordance with the 2014 dictation of curriculum 2013, which in general the 2013 curriculum developed based on three factors: internal challenges, external challenges, and an improvement over mindset [1].

The books are the learning component necessary for the study of a particular material, where students can learn independently. In addition to the communications networks of technology harvesting such as the website, there should be a tremendous range of tools available to teachers and students with a view to building the skills, knowledge, and expertise needed in the work and life of the 21st century [2]. So, utilizing network technology, an e-book is combined with the website.

The media teaching of the e-book-based website is a media that has a purpose to facilitate communication in learning [3]. The teaching material that can make learning more interesting, interactive, and efficient is e-book [4], a converted text book into digital format, the e-book also has a sense as a learning environment that has an application that contains a multimedia, instructional resource database that stores a multimedia presentation on the topic in a book [5].

Further highlighting the excelling value of e-book learning is supported by Darlen research with the interactive e-book development theme for junior physics showing the product development of an interactive e-book interactive grade VIII junior high school physics resource [6]. Illa also tells of the interactive e-book that the use of e-book can interact between teachers and students in remote
learning and the students are more interested in using the e-book in learning [7]. It corresponds to what will be developed as an interactive e-book source for learning physics. The focus to be achieved on the developed e-book is to increase interaction between teachers and students in close-or remote learning, wherever and whenever, such as e-learning. Astrini with the theme of developing interactive e-book media on the structure and function of plant organ tissues stated that the interactive e-book media developed was feasible with an overall average of 94% and the videos presented could clarify understanding of the concept [8]. This is important to develop through e-books, which display interactive videos that can guide students to understand a material through visualizations such as images, audio, video or animation of physics learning.

Some of the results of web-based learning make no significant difference to traditional (face to face) and positive responses from web-based learning users because one can be accessed at any time or place [9]. Web-based use of learning media has a higher metacognitive capacity than those using web-based learning media [10]. Regarding the discussion of fluid materials is found in Nisrina research which reveals the mastery of fluid concepts in students taught with interactive multimedia-based learning higher than those taught with conventional learning [11]. With this web-based e-book combination that contains hyperlink’s menu of discussion rooms, it is expected that students will be able to write their criticisms.

In addition to the use of Internet networks, and regardless of the importance of the use of teaching materials in learning, the model of learning is an essential component that can sustain the achievement of the purpose of learning [12]. According to the purpose of learning, good educators should begin with an improvement in the learning process done by offering an approach or strategy that can improve learners’ ability and results. One strategy has been Problem-Based Learning (PBL) model. This PBL study is a problem-based learning model that first appeared during the learning process [13]. This was consistent with the problem that occurred in the class, where the use of the PBL changed the condition of passive learning to be active and creative or that was said teacher oriented to student oriented.

Research conducted on Aji states on the theme development of pbs-based physics learning modules to increase the ability to solve physics results that an PBL physics-based learning module on the topic of balance and oscillation can improve the student physics solving capability. This can be known by the assessment of the material experts and the physics teachers on the is worth component, which is that the issues presented can improve the problem-solving ability of learners who get a percentage of 91.7% [14]. Mahayuki also wrote about the development of a problem-oriented e-book to improve a student's critical thinking skill with a problem-based e-module use will direct learners to solve the problem on their own and this will be a real experience in solving the problem [15]. It relates to the research developed that is with websites based PBL models. The e-book model PBL is complemented with interactive videos, visual images/pictures that adjust with physical problems so that students can have critical thinking ability and problem-solving ability to acquire knowledge concepts. The e-book also has a report card for the summative and formative and experimental evaluations so that the student can visualize and pour out creative ideas and find solutions for the project.

Based on the above, it will be necessary to study the development of a steady, steady, and dynamic website-based e-book development with a PBL model to enhance the problem-solving capabilities of student physics at the Jakarta state university physics education.

2. Research Methodology
The research method used Research and Development (R&D) method which is the method used to develop and validate a product used in learning. The development model to be used is the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation).

This begins the gradual stage, identifying problems in research and knowing what students and educators need in learning physics. Early studies were analysis of needs and a study of literature. The design phase, the design plan e-book needs, the analysis of the students’ characteristics that will use e-book, divide and conceptualize matter into sub materials, determine the content in the e-book (text, picture or graph, video, and evaluation), transcribe e-book scripts, specify e-book instruments. The e-book container is a website that requires designing web links, websites, website template, and hosting
The stage of development, incorporating material content such as title-writing, writing text using the Microsoft Office Word 2019, creating a front and back cover of e-book and creating pictures using a Corel Draw X5 and is stored in PNG format, editing a supporting video of materials using inshot software, making an formative evaluation using Google Form software, combining all of the content of the e-book (text, image or graph, video, animation, and evaluations) by using a professional PDF flip and Posting it on the website. The intrinsic stage, the resulting data is derived from the validation of media experts, materials experts, learners, graphic design experts, the physics faculty test, and students.

2.1. Data Analysis Techniques
Assessments of validation tests and product tests are calculated based on scores of acquisitions on each aspect, in the following ways:

\[
P = \frac{S}{N} \times 100\%
\]

*P* = The percentage of success (%)
*S* = The total score
*N* = The maximum score

Data obtained, then quantifies the interpretation of the score, as follows (Riduwan, 2007).

| Percentage (%) | Interpretation          |
|----------------|-------------------------|
| 76 – 100       | Well Deserved           |
| 51 – 75        | Worthy                  |
| 26 – 50        | Unfit                   |
| 0 – 25         | So Unseemly             |

To see the difference between the value of physics problem solving ability of students in static fluid and dynamic fluid using e-books with PBL models and e-books without PBL models, so that the gain value t-test can be used, with notes \( N_1 \neq N_2 \) and \( t_{\text{count}} > t_{\text{table}} \) can be written the following equation (Farida, 2017).

\[
t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{SD_1^2}{N_1} + \frac{SD_2^2}{N_2}}}
\]

*\( t \) = The number or degree coefficient of the mean of the two groups
*\( \bar{X}_1 \) = The average distribution value of the experimental class
*\( \bar{X}_2 \) = The average distribution value of the control class
*\( N_1 \) = Number of experimental class samples
*\( N_2 \) = Number of control class samples
*\( SD_1^2 \) = The value of the distribution variance of the experimental class sample
*\( SD_2^2 \) = The value of the variance of the control class sample distribution

Next, the D'Cohens test was carried out to test whether there was an effect of the e-book with the PBL model on the ability to solve physics problems, which D'Cohens' interpretation was as follows (Santoso, 2010).
| Effect Size | Information |
|-------------|-------------|
| D < 0.8     | Large       |
| 0.2 < D < 0.8 | Medium     |
| D < 0.2     | Small       |

3. Result and Discussion

The e-book media draft that is made include the cover, the introduction, the usage guide, basic competence, the table of contents, on the e-book, glossary, history of scientists, the library list. Here will show you the developed e-book draft:

![E-book display](image)

(a) **Figure 1.** E-book display (a) Cover (b) Concept map

The e-book media based websites with PBL models can be viewed at www.physicse-bookfluid.com. Here will be shown a website based media e-book with an email model:

![E-book web-based with PBL on display](image)

(a) Student orientation on problems & Organizing students to study (b) Guiding individual/group investigations  
(c) Develop and present the work (d) Analyze and evaluate the problem-solving process
The static fluid and dynamic fluid e-book media are arranged based on the problem-based learning model as follows:

| Stages of Problem-Solving Skills | Indicator |
|----------------------------------|-----------|
| Visualize the problem            | Visualizing the problem into a visual representation |
| Identify problems based on basic concepts |
| Describe the problem in physics description | Turning visual representations into physical descriptions |
| Create a free body diagram/sketch that describes the problem |
| Determine the quantity in question which is known according to the diagram/sketch |
| Plan the solution                | Converts physical descriptions into mathematical representations |
| Determine the right equation for problem solving |
| Execute the plan                 | Substituting the value of a known quantity into the equation |
| Make a list of known quantities according to the diagram/sketch |
| Determine the quantity in question which is known according to the diagram/sketch |
| Check and evaluate               | Evaluating conformity with the concept |
|                                  | Evaluating units |

The asset-based e-book worthiness test using PBL models is done using methods of spreading questionnaire to media experts (professors), materials (professors), teachers (professors), and users (professors and students).

Validation of media experts is to test the feasibility and get the opinion of the developed e-book and to obtain information of corrections, Suggestions, and critics to evaluate and revise e-book. According to media expert tests, the average percentage of assessments given by media experts is 90.31% with very decent interpretation. This suggests that the developed e-book is already worth using in the study of physics.

![Media Expert Feasibility Trial Results](image)

**Figure 3. Diagram Percentage of Media Expert Validation Result**

Validation of the material experts aims to know the worthiness of the material in the e-book developed for static and dynamic fluid materials and obtain information of improvements, Suggestions, and criticisms to evaluate and revise the material to the learning media. Based on the results of the validation of the material experts, the average percentage of assessments given by the material expert is 94.94 with very reasonable interpretation. This suggests that the developed e-book is already worth using in learning.
Validation by the learner is intended to know the worthiness of the stages of learning presented in the form of the developed e-book and to obtain information of improvements, suggestions, and criticisms to evaluate and revise the stages of the learning process on the e-book. Based on the researchers’ validation test, the average percentage of assessments given by the learner is 77.09% with a perfectly feasible interpretation. This suggests that the developed e-book is already worth using in learning.

College's trial was based on feasibility on content, presentation, language, and grafting. According to the professor's test, the average percentage of the score given by the professor of physics is 96.93% with a very decent interpretation. This suggests that the developed e-book is already worth using in learning.

| Table 4. Test Result of Physics Educator’s |
| Aspect       | Result  |
|--------------|---------|
| Content Eligibility | 98.96   |
| Presentation  | 95.00   |
| Language      | 95.85   |
| Graphic       | 97.92   |
| **Overall Percentage** | **96.93** |

The developed e-book is validated by media experts, material experts, and learning experts. The results of the validation are used as material for evaluation and improvement of e-book development.
Next, a small group trial was conducted with 5 (five) students. Based on the results of small group trials of students, the average percentage of assessments given by students is 91.04%.

| Table 5. Test Result of Small Groups of Students |
| Aspect         | Result |
|----------------|--------|
| Content Eligibility | 91.67  |
| Presentation     | 87.50  |
| Language         | 90.00  |
| Graphic          | 95.00  |
| **Overall Percentage** | **91.04** |

The results of the evaluation of the large group of students test on e-book obtained results that the developed e-book can be a good learning resource for students to understand physics materials. After a revision of development, the e-book was tested as a lesson in the Jakarta state university physics study program 2020/2021. The assessment given by students consists of the feasibility of content, presentation, language, and grafting.

| Table 6. Test Result of Large Groups of Students |
| Aspect      | Result |
|-------------|--------|
| Content Eligibility | 87.79  |
| Presentation | 85.83  |
| Language    | 91.25  |
| Graphic     | 89.72  |
| **Overall Percentage** | **88.65** |

Based on the results of the large group test results for students acquired an average percentage of assessment of 88.65% with an interpretation that is perfectly feasible. This suggests that the developed e-book has been worth using on the study of physics.

To measure the effect of website-based static fluid and dynamic fluid e-books with the PBL model on improving students' physics problem solving abilities, the t-test gain value was used in both the experimental class and the control class. Based on the t-test, the gain value shows the results of the $t_{count} = 8.58 > t_{table} = 2.01$ so it can be said that the results of the experiments carried out have an influence on the experimental class.

The level of contribution (D'Cohens test) of the e-book with the PBL model is 2.51 so it can be said that the e-book with the PBL model on improving students' physics problem solving skills has a contribution to the high category level. This makes a student's involvement in problem-based learning that can listen to a variety of perspectives and can improve high level thinking ability [16].

4. Conclusions

Based on the validation tests by materials, media experts, and learning experts, and field tests, as well as field tests, it can be concluded that the e-book static fluid and dynamic fluid website based models with advanced PBL models are worthy of independent teaching to enhance student physics problem solving.

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