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ORIGINAL RESEARCH

Development of a Practical Pocketbook Based on PjBL to Improve Understanding of Fluid Dynamics Concepts in Class XI

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Abstrack

This This study is a pre-experimental study that aims to describe students' communication skills before and after the implementation of virtual laboratories with problem-based learning, as well as analyze the improvement of students' communication skills in high school after participating in learning using virtual laboratories with problem-based learning. The design in this study is a One Group Pretest-Posttest design, with a population and sample of 30 students selected using saturated sampling techniques. The instrument used to collect data is an essay test consisting of 15 questions developed according to the indicators of students' communication skills, namely interpreting graphs, interpreting tables, interpreting images, changing the form of presentation, drawing conclusions, providing reasons, and explaining the results of observations. The data obtained in this study are quantitative data analyzed using descriptive statistics and inferential statistics. Based on the research data, it was found that high school students' communication skills are in the moderate category with an average N-Gain value of 0.68. Meanwhile, the results of the significance test using the Wilcoxon Signed Rank test showed a p-value of 0.001, which is smaller than 0.05. This indicates that the implementation of virtual laboratories with problem-based learning can improve students' communication skills.

Keywords: Virtual Laboratory · Problem Based Learning · Communication Skills

INTRODUCTION

Physics as a basic science requires conceptual understanding and practical skills in learning, but physics is often considered difficult because the material is abstract and mathematical (Yanti et al., 2022). Based on research Fathiah and Kaniawati (2020), the implementation of physics learning in schools on the subject of fluid dynamics, 53% of students stated that they had difficulty understanding this material. This is influenced by learning that focuses too much on theory and does not involve experimental activities (Dinawati et al., 2022). In fact, practical activities are very important to bridge abstract concepts into more concrete ones (Agustina et al., 2022). Practicals allow students to be directly involved and apply them in real life (Delti, 2022).

Unfortunately, the implementation of practicums has not been fully implemented, as seen from data from several high schools in Kupang City, which are still not effectively implemented. Based on the results of a 2024 PPL student survey, of 13 public high schools in Kupang City, only 6 schools have active laboratories and practicum guides, while the other 7

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schools have not utilized their laboratories optimally. The main obstacles faced are the limited availability of interesting and interactive practicum guides, as well as the lack of integration between practicum activities and learning approaches that empower students. A similar condition was also found by researchers when carrying out PPL activities at SMA Negeri 11 Kupang, where teachers still rely on textbooks and LKPD as the main guides for practicums. The use of LKPD tends to be less interesting and limited in presenting information and visualizations that should support student understanding more interactively (Sumaeni et al., 2022). Therefore, innovative, easily accessible practicum guide media are needed that can facilitate student independent learning.

To address these issues, it is necessary to develop innovative learning media that are relevant to technological developments. One approach that can be used is Project-Based Learning (PjBL), which encourages active student engagement through projects designed to solve real-world problems (Utami et al., 2023). The PjBL model is able to integrate practical activities into meaningful projects, encourages student creativity and independent learning, and is not limited to the laboratory (Anjarwati et al., 2020).

As a supporting medium, the development of a digital-based practical pocket book using the Book Creator platform was chosen because of its ease of creating interactive digital content, including text, images, audio, and video. The disadvantages of this media are its dependence on digital devices and internet connections, and it requires short training for users who are not familiar with the application (Destiani, 2023). However, its advantages in flexibility and visual appeal are considered to overcome the limitations of conventional practicum guides. This media offers an attractive, flexible visual display and can be accessed through digital devices, making it easier for students to understand practicum procedures and concepts (Kobesi et al, 2022). Based on this, this study proposes a solution for developing a Practical Pocket Book based on PjBL on fluid dynamics material in grade XI high school. This solution is expected to make it easier for students to understand fluid dynamics material in practicum activities that can be accessed anywhere and anytime. This practical pocket book is expected to help students improve conceptual understanding, practicum skills, and student creativity in learning physics.

METHOD

Research uses a quantitative approach with data in the form of numbers or numerical values that can be measured statistically. This is implemented with use method research and development that adopts the ADDIE model. Stages the ADDIE model includes five main steps, namely Analysis, Design, Development, Implementation, and Evaluation.(Anjarwati dkk., 2020).

The product validity test was conducted by lecturers from the Physics Education study program. To assess student responses to the practicality of the product, the media was tested by eleventh-grade students of SMA Negeri 11 Kupang. The data obtained from the validity and practicality tests to assess initial responses consisted of two types: quantitative and qualitative. Quantitative data was obtained through the calculation of the average expert validation and the initial student response questionnaire. Meanwhile, qualitative data was obtained through observations, comments, and input for improvements provided by expert validators and students.

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Data Collection Instruments

The instrument used in this study was a questionnaire. The questionnaire was divided into three types: (1) material expert validation sheet, (2) media expert validation sheet, and (3) student initial response questionnaire. The research subjects consisted of 30 students of class XI IPA at SMA Negeri 11 Kupang.

Data Analysis Techniques

Data analysis techniques were used to determine the feasibility of the developed media. Data in this study were collected using a Likert scale with a value range of 1 to 4, with 1 being the lowest score and 4 being the highest. Table 1 presents the Likert scale.

Table 1. Likert Scale Criteria

Criteria	score
Very good	4
Good	3
Need Improvement	2
Poor	1

After obtaining validation data from experts, the question items will then be calculated using Equation 1:

$$\bar{x} = \frac{\sum x}{N} \quad (1)$$

where: R = Average score; $\sum x$ = Total Score; and N = Number of assessors. Based on the scores obtained from media experts and material experts, then the final score is adjusted according to the eligibility criteria based on Table 2. (Nurhairunnisah, 2017)

Table 2. Eligibility Criteria

Interval	Criteria eligibility
$x \geq 3{,}25$	Highly Feasible
$3{,}25 > X \geq 2{,}50$	Feasible
$2{,}50 > X \geq 1{,}75$	Moderately Feasible
$X < 1{,}75$	Less Feasible

Furthermore, to see the students' response to the media, it can be calculated using Equation 2.

$$N = \frac{K}{NK} \times 100\% \quad (2)$$

with N = Percentage score; K = acquisition score; and NK = maximum score (Sugiyono, 2019). Based on the results of the calculations, the scores obtained will be adjusted to the following qualitative criteria Table 3.

Table 3. Criteria Response Students

Interval	Criteria eligibility
Score > 81.25%	Very good
62.50% < Score ≤ 81.25%	Good
43.75% < Score ≤ 62.50%	Adequate
25% < Score ≤ 43.75%	Inadequate
Score ≤ 25%	Highly Inadequate

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RESULT AND DISCUSSION

Analysis Stage

This analysis stage begins with an analysis of student needs and the applicable curriculum to understand existing needs. Curriculum analysis is conducted by considering key components, such as learning outcomes, evaluation, and the media used. The goal of this step is to ensure that the development process aligns with the curriculum and meets student needs.

From the observation results, the main guides used during the practicum activities were textbooks and Student Worksheets (LKPD). The use of this limited practicum guide made the practicum activities less effective; in addition, the laboratory that should have been used for practicum was converted into a classroom. To overcome this problem, the initial planning will focus on development based on project-based learning (PjBL). This approach is expected to meet the needs of students and the demands of quality education in this technological era. This research is in line with findings (Sabaruddin, 2022) regarding the development of technology in the school environment.

Design Stage

In the design stage, the researcher created a product framework that served as a reference for the media development stage. In addition, the researcher also designed the instruments to be used in the research. The website used in developing this practical pocket book is Book Creator. The storyboard for this practical pocket book was designed and adapted to the syntax of the project-based learning (PjBL) model.

Development Stage

The results of the development stage were carried out through 3 stages, namely: (1) developing the product, (2) validating the media, and (3) revising the product based on comments and suggestions from media experts. Based on the storyboard in the previous stage which includes dynamic fluid material, as well as key features that include a consistent and interactive layout and integrating videos and project activities that are relevant to the problem. The following are screenshots of the product shown in Table 4.

Table 4. Media Display

	Picture
Front view	

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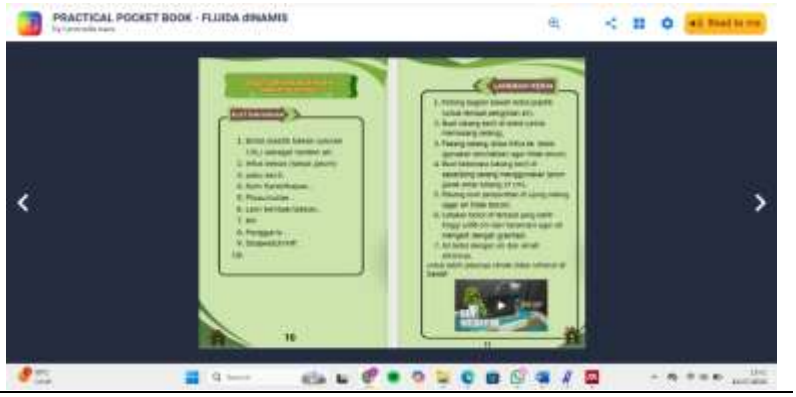
	Picture
Project activity view	
Project progress video	

The products that have been developed are then validated by material experts and media experts, as in Table 5 and Table 6.

Table 5. Results of Material Expert Assessment

No.	Aspect Evaluation	Average score
1	Eligibility content	3.6
2	Compliance with the PJBL model	3.5
Average score overall		3.55
Category		Highly Feasible

Table 6. Results of Material Expert Assessment

No.	Aspect Evaluation	Average score
1	Appearance	3.0
2	Programming	3.2
Average score overall		3.1
Category		Feasible

Implementation Stage

The implementation phase was conducted once on a large scale with the aim of observing students' initial responses to the developed media. The trial was conducted at SMA Negeri 11 Kupang, involving 30 students divided into 15 students from class XI IPA 1 and 15 students from class XI IPA 2. Through a questionnaire distributed after students accessed the product and carried out project activities. The trial results can be seen in Table 7.

Table 7. Results of Material Expert Assessment

No	Indicator	Amount score	Maximum score

1	Learning Aspect	740	840
2	Appearance Aspect	830	960
3	Programming Aspect	515	600
Total		2085	2400
Percentage score		$\frac{2085}{2400} x\ 100\ \% = 86{,}88\ \%$	
Category		Very good	

Based on the calculation, it can be seen that the results of student responses to the developed media obtained a score of 740 from a maximum score of 840 in the learning aspect, which means that the achievement of competencies from the material and learning objectives using this project-based learning model is good. Then, in the second aspect, namely the appearance aspect, it got a score of 830 from a score of 960, indicating that the visual and audio media display is attractive and interactive in the learning process, finally in the programming aspect, it got a score of 515 from a maximum score of 600, meaning that the technical functionality of the media is good. Overall, the total score obtained was 2085 from a maximum total score of 2400 with a percentage of 86.88% included in the "Very Good" category. Showing that this media facilitates project-based practicum activities that actively involve students in the learning process. This finding is consistent with research by (Rauziani dkk., 2016) showing that the PjBL learning model can increase student involvement and participation in learning.

Evaluation Stage

The evaluation stage is the final process that aims to conduct revisions based on input and suggestions from students in the previous stage to perfect the media so that it is suitable for use in practical activities. The evaluation was conducted to obtain a product that was declared suitable by expert validators and received positive responses from students. Based on the results of the validation test, the Practical Pocket Book was deemed to meet the aspects of suitability of content, appearance, and usability of the media. In addition, student responses indicated that this media facilitated their understanding of fluid dynamics material. Therefore, the product was declared ready for use in learning activities without the need for further improvements.

CONCLUSION

This research resulted in *a Practical Pocket Book* based on *Project Based Learning* for Dynamic Fluid material in grade XI which was declared very suitable with an average score of 3.55 by material experts and 3.1 by media experts. This media also received a very good response from students with a percentage of 86.88% in the very good category. Thus, *the practical pocket book* This is expected to improve students' understanding of fluid dynamics material, as well as facilitate project-based experiments in high school physics learning.

DECLARATION

The author hereby declares that the manuscript entitled "Development of a Practical Pocket Book Based on Project Based Learning on Dynamic Fluid Material in Grade XI" is the result of independent idea construction based on field observations, theoretical studies, and authentic data analysis. This manuscript does not contain any part that is the result of substantial

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