Design and Validation of Dynamic Fluid Experiment Devices as a Media of Physics Learning

Fenny Suhartiwi
Hadis Mariyo, Dila Rizki Aryani

Faculty of Teacher Training and Education, University of Riau
Emil: fsuhartiwi@gmail.com

ABSTRACT

Media usage of teaching in schools very important role for students and can assist students in the learning process and can improve student learning outcomes. This research aims to design build and validate device of fluid dynamic experiment as learning media of physics in school. The subject of this research is an experimental device consisting of experimental tools and manuals. Data collection using a validation assessment sheet provide to a validator consisting of five people. Data were analyzed descriptively to determine the result and the value of its validity. The results of data analysis obtained from the assessment of validation that is, in the experimental tools and manuals got average score 3.46 and 3.60 with very high category. The dynamic fluid experimental device has been declared valid, resulting in an experimental device that is eligible to be used as a media of physics learning in school.

***Keywords**: Validation, Experiment Device, Learning Media.*

Introduction

The learning process based on the curriculum needs to be supported by the learning media (Hidayati et al., 2012). The use of learning media or experimental tool is instrumental in developing student's thinking, reducing the occurrence of verbalism, increasing interest and attention of students to learn, and improve student learning outcomes (Hartati, 2010).

According to Civelek et al., (2012), learning by using physics learning media can give positive impression to the students, so that students will be motivated in learning and physics learning into lessons that will be interested by students. Ricka (2017) states a learning media is said to be worthy of use if it has passed the testing phase, both in the form of design and validation of the device. Validation on the experimental device to produce a product that matches the purpose of the research (Susilowati, 2013).

Paldi (2011) reveals some of the steps applied to validate experimental devices, the first step is design by looking for a problem and carried out a preliminary studies, then preparation and manufacture of the device, then testing the validity of the experts and product revisions in the second stage. According to Rina (2016) in the validation stage also made some improvements and refinement to the product so that the value of the validity of experimental devices with high category and have good quality. Questionnaires were given to experts to provide a judgment of a worthy trial device to uses as a media of learning.

Previous research done by B. Hartati (2010) revealed the validation result from friction force learning media able to improve critical thinking skill of students with t value 5,389

with significance level equal to 0,05 and can increase learning outcomes from 65,24 up to 70, 63. So it can be said that friction force feasible (valid) used in learning, because it can improve critical thinking skills and student learning outcomes. Based on this information, this study aims to design dynamic fluid experimental devices and design a manual for the use of valid dynamic fluid experiments for use in school.

Methodology

The method used in this research is Research and Development (R & D) which adapted from Sugiyono (2009). The research was conducted in the Laboratory of Physics Education Program of Riau University. Stages of the research flow can be seen in Figure 1.

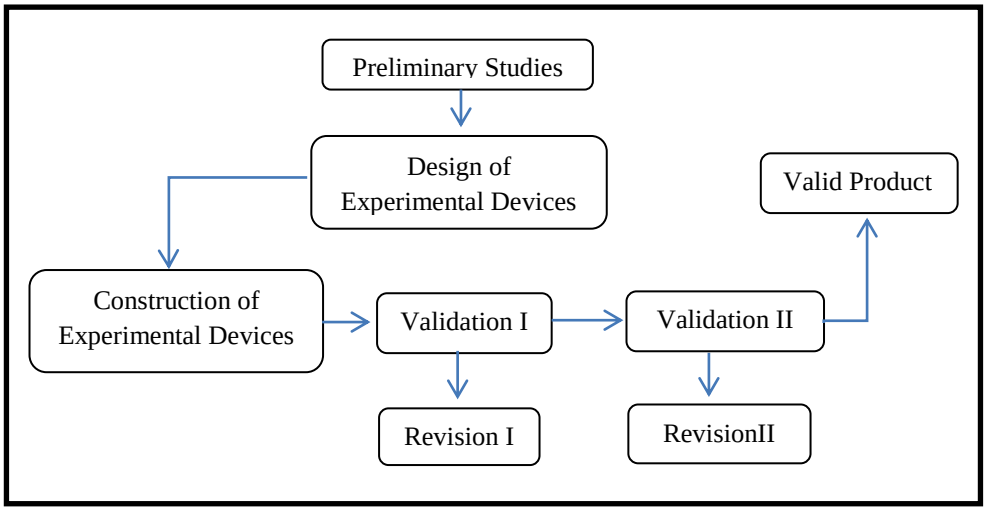

Figure 1. Stage of The Research Model

Based on the stage of the research flow in Figure 1, which is a preliminary study, conducted through interviews and observation to school. The experimental design stage begins with the design of a dynamic fluid experimental tool. The design was made in advance in the form of sketch drawings, after that discussed with lecturers and experts for the completion of sketches of experimental drawing tools.

The experimental device manufacturing process consists of an experimental tool and manuals. At this stage the design has been made to be adjusted again with the needs to be achieved. The design of the manufactured product should be able to show physical phenomena about the dynamic fluid, i.e. turbulent flow, laminar, Bernoulli and Torricelli. The product made will be an experimental device that is ready to use without having to assemble in advance in its use.

The experimental device to be validated consists of two components, namely the dynamic fluid experimental tool in the form of construct validation and manual of experimental tools in the form of content validation. The experimental device validation is validated twice, which is the first validation for the revision of the tool fix and second validation of the scores and suggestions for further improvement of the tool. The dynamic fluid experiment device is validated by three lecturers and two physics teachers, where the

validator is an expert in the development of instructional media. Fixed fluid experimental device product improvements are made based on suggestions from validators. The object of this research is dynamic fluid experiment device. The data source was obtained from the questionnaire given to the validator to get the assessment.

The data collection technique used is to fill the instrument in the form of questionnaire. The experimental device assessment sheet is performed to obtain data from the validator. Data analysis technique used in this research is quantitative descriptive analysis. Assessment of validation sheets using Likert scale as shown in Table 1.

Table 1. Category of Validation Sheet Evaluation (Djaali and Pudji, 2004)

The average rating category of indicators

No	Category	Score
1	Strongly Agree	4
2	Agree	3
3	Disagree	2
4	Strongly Disagree	1

based on the Likert scale on the experimental device can be seen in Table 2.

Table 2.Category of Validity

No	Average Score	Category	Value of Validity
1	$3{,}25 < S \leq 4$	Very High	Valid
2	$2{,}5 < S \leq 3{,}25$	High	Valid
3	$1{,}75 < S \leq 2{,}5$	Low	Invalid
4	$1 \leq S \leq 1{,}75$	Very Low	Invalid

The experiment tool is said to be valid if all indicator ratings by the validator are within the score range $2{,}5 < S \leq 4$, if one of the indicators is in the range of $1 \leq S \leq 2{,}5$ then performed improvements on the indicator until the experimental device is said to be valid every indicator.

Result and Discussion

Research and development is experimental device validation as a media of physics learning in school. The experimental device was validated by three physics education lectures and two physics teachers. The device to be validated consists of a dynamic fluid experiment tool and manual.

The dynamic fluid experiment tool has been validated by validator so that it is declared valid. In Table 3 is a recapitulation of the validation of dynamic fluid experiments consisting of six indicators with valid categories.

Table 3. Recapitulation of Validation Result of Dynamic Fluid Experiments Tool

No	Indicator	Average	Category
1	Functional	3,7	VH
2	Easiness	3,2	H
3	Safety	3,58	VH
4	Size	3,7	VH
5	Aesthetics	3,1	H
6	Accuracy	3,5	VH
Average Indicator		3,46	VH

Based on the results of the assessment by the validator in table 3 obtained, each indicator is in the range average score of 3,7 to 3,1 with very high and high category. The average score of very high indicators is on the functional, safety, size and accuracy of the tool with the subject matter. For indicators with high category is the easiness and aesthetics of the tool.

The functioning of the experimental tool can show symptoms and phenomena observed in accordance with the concept of dynamic fluid. Ease of tools is easy to do preparation both

before and after the experiment, because the tool is more practical and ready to use without being strung together first. The size of the experimental tool is very visible and movable position, so it is easy to contain. The accuracy of the tool in accordance with the concept of dynamic fluid so as to facilitate students in experimenting.Safety in using the tool that is safe experiments of chemicals, not easily broken and safe from objects that make cuts. In the aspect of aesthetic assessment there are two components, namely the experimental tool has an interesting shape and the structure of the experimental tool easy to see. The experimental tool consists of three tools, namely the experimental tool to show the symptoms of laminar and turbulent flow, flow rate with different cross-sectional area (venture meter tube), and application of Bernoulli on Torricelli.

Validation of manual is performed in the same way as the experimental tool validation. Questionnaires used separately with a questionnaire of experimental tools. The result of the validation assessment of the manual of fluid dynamics experiments given by the validator can be seen in Table 4.

Table 4.Recapitulation of Validation Test Result of Dynamic Fluid Experiment Tool Manual

No	Indicator	Average	Category
1	Accuracy of Content	3.7	VH
2	Appearance	3.4	VH
3	Easiness	3.7	VH
Average Indicator		3.6	VH

Based on Table 4, it is found that each indicator of manual guidance validation is in very high category with average score range of each indicator of 3,4 to 3,7. The accuracy of content indicator is developed into two components assessed by the validator, namely the format of writing in accordance with the guiding principles of the manual and procedures in accordance with the purpose of the experiment. On the appearance of the tool manual, the grammar according to rules and writing easy to read. To provide convenience in the manual made the instructions are clear enough so that the experimental steps easy to understand.

There are some suggestions given by validators when validating experimental devices, i.e., laminar and turbulent flow experiments have less rapid flow of water in the tube, causing difficulty in observing the flow. This is caused by the water pump used has a small size and the resulting pump power is also small. So the validator suggested to replace the pump with a size large enough so that the pump issued power is also large. To convenience in observing the flow of laminar and turbulent it must use a floating object. The venture meter tool should use a large cross-sectional area of the difference, so that the Bernoulli phenomenon is clearly visible to the observer. And the manual should have clear steps, especially in getting quantitative data.

Conclusion

The process of making an experimental device in accordance with the procedure *R & D* has been done validation and valid used as a media of physics learning in school. The design of experimental device consist of a dynamic fluid experiment tool and manual. Experimental device after validation of experimental tools and manual of average validation scores is categorized as very high. From the results of data collection and analysis, the dynamic fluid experiment device has been valid and suitable for use as a media of physics learning in school.

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