Development of Learning Media using Hydraulic Demonstrations to Increase Learning Outcomes of Mechanical Engineering Students

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Abstract. The hydraulic learning process used so far is still using power points as well as books, which makes the hydraulic system learning process less effective. Hydraulics is a tool that has various invisible working systems, where the hydraulic working system is closed with a tube whose work system requires oil, water, and pressure. the need for teaching aids in the teaching and learning process about the hydraulic system so that mechanical engineering students can understand the hydraulic work process directly, which is expected to improve the learning outcomes of mechanical engineering students. as the research method used is a 4D model (define, design, develop, and disseminate). The results showed that the validation value of teaching aids was 87.19% (very good), the content validation was 82.67% (very good), the practicality of teaching aids, when used by lecturers, was 83%, and the effectiveness of teaching aids in terms of student activities was 75.33%. Learning outcomes after using hydraulic system props had a completeness of 83.33% and an incompleteness of 16.67%.

Keywords: Learning Media, Teaching Aids, Hydraulics, Learning Outcomes

1 Introduction

The increasing development of the world of education today, which is entering the era of globalization and digitalization, is marked by incessant technological innovation [1]. thus demanding an adjustment of the education system that is in line with the demands of the world of work [2]. Education must reflect the process of realizing all of one's potential in order to gain skills that can be used in everyday life in society [3].

In the educational process at the university, learning activities are the most basic activities for seeing success in achieving learning objectives. Learning is a process of changing behavior that is expressed in the form of mastery, use, and assessment of basic attitudes, knowledge, and skills contained in various fields of study or more broadly in various aspects of organized life [4].

The occurrence of an effective learning process is strongly influenced by factors that can affect student learning outcomes, one of which is the factor of interest and effort [5]. Learning with interest will encourage students to learn better than learning without interest [6]. The purpose of each learning process is to obtain optimal results. Learning outcomes are important because they can be used to assess a student's understanding of a concept as well as the effectiveness of a teacher's learning method [7]. One level of student success is the role of the teacher, who designs, manages, and evaluates learning outcomes.

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The learning process will be more effective if the objects and events that become teaching materials can be realistically visualized to resemble the actual situation. Media teaching aids for teachers are not only a tool but also a means of carrying the information needed by students to recognize the real components in accordance with the learning material [8].

Learning of hydraulic and pneumatic systems is a technology that utilizes a liquid substance to perform movement or rotation; this system works on the principle that if a liquid is subjected to pressure, the pressure will propagate in all directions without increasing or decreasing the strength of Archimedes' law [9]. In this case, the application of hydraulic and pneumatic systems in industry as a working medium Therefore, in the learning process for the Hydraulics and Automatics course, there are still values that are less than optimal in learning completeness because the learning process still uses lecture, PowerPoint, and video methods on hydraulic and pneumatic work systems, which only provide knowledge and understanding to students [10]. Because of this, a learning innovation that is movement, work system, visual aids, to support the teaching and learning process as a means of support, a means of conventional learning transformation, in the learning process of Hydraulics and Pneumatics. Therefore, in the hydraulic and pneumatic learning process, it is very necessary to have a learning innovation, that is, movement, work systems, and teaching aids, to support the teaching and learning process as a means of support, a means of transforming conventional learning [11]. [12].

The use of teaching aids or learning media is an inseparable part and has become an integration of the learning methods used in the hydraulic and pneumatic learning processes [13]. [14]. Teaching aids in the teaching and learning process and is one of the dynamic elements of learning. The position of teaching aids has an important role because it can help the teaching and learning process carried out at the university [15].

A lecturer's teaching ability also necessitates learning methods that can improve student learning outcomes; many educational practitioners recognize the use of media or assistive devices to greatly assist learning activities both inside and outside the classroom, particularly in helping to improve student learning achievement [16]. Props are needed, especially to explain abstract concepts or material. So in the teaching and learning process, teaching aids are used with the aim of helping teachers make the student learning process more effective and efficient.

Based on the background, it is necessary to conduct research on the development of learning media for hydraulic system teaching aids to improve student learning outcomes.

2 Research Method

The research method was carried out using the 4-D method, which consisted of 4 stages of development, namely: 1) definition, 2) design, 3) development, and 4) distribution. The research was conducted at the Mechanical Engineering Education Study Program, Faculty of Engineering, State University of Medan. In the class of 2020-2021 students, there are 2 classes with a sample of 30 students.

Data collection with an Expert validation process in the use and accuracy of teaching aids media that will later be used, besides the material validation process is also carried out, this is done for the process of perfecting hydraulic and pneumatic learning courses, expert validation processes carried out by Lecturers of the Engineering Education study program Machines at the Faculty of Mechanical Engineering who understand about work processes and tool work systems, while the research development procedures are shown in Figure 1.

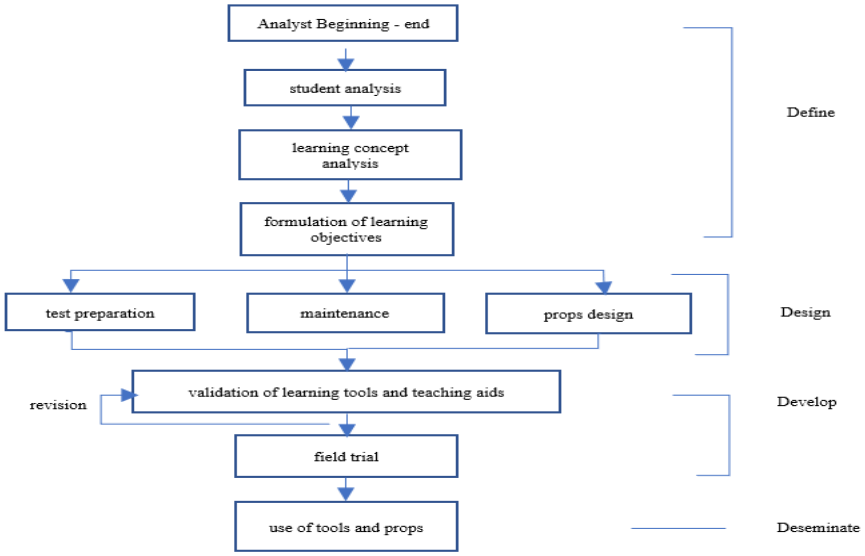

Figure 1. Research Planning

The process of implementing the data analysis used is descriptive analysis, which is carried out with the aim of knowing the quality of the product in the form of hydraulic and pneumatic learning aids.

3 Results and Discussion

3.1 Validator Assessment Stage

The results of quality and efficiency in teaching aids media are based on expert validation with several assessment indicators to improve teaching aids media quality. In the initial process, it is necessary to validate the construction of teaching aids by assessing several aspects, namely: 1) relationship with teaching materials; 2) resistance of teaching aids; 3) safety of teaching aids; 4) aesthetics of teaching aids; and 5) linkage of teaching aids with materials. From the five aspects of the assessment of teaching aid constructs, the scores are obtained in Table 1.

Table 1. Score of the Construct Validation Recapitulation of Teaching Aids

validator	Aspect						
	1	2	3	4	5	Amount	Percentage
Validator 1	85,5	84,6	90,2	84,7	88,8	433,8	86,76
Validator 2	83,4	88,7	88,8	86,5	87,9	435,3	87,06
Validator 3	88,5	86,7	86,5	88,5	88,6	438,8	87,76
Amount	257,4	260	265,5	259,7	265,3	1307,9	
Percentage	85,8	86,67	88,5	86,57	88,43	87,19	

Table 1 reveals that the results of the assessment of the construction of props for Validator 1 are 86.76 percent (very good), 87.01 percent (very good), and 87.76 percent (very

good). The highest score of 88.5% (very good) was obtained in the third category, while the lowest score was 85.8%. The overall results of the evaluation of the five aspects yielded an average score of 87.19% in the category (very good), so the evaluation of the tool's construction suggests that the use of media-based teaching aids in the teaching and learning process of hydration is effective.

The process of evaluating material content validation for the use of teaching aids must also be conducted, as there is a need for materials in hydraulic and pnewmatic learning, in which the assessment criteria are 1). Suitability with Learning Objectives, 2). Conformity with Content, and 3). the Learning Process Suitability of Teaching Aids.

Table 2. Score of Material Validation Results on the Use of Teaching Aids

Validator	Aspect				
	1	2	3	Amount	Percetage
Validator 1	13	14	13	40	80
Validator 2	14	14	15	43	86
Validator 3	14	14	13	41	82
Amount	41	42	41	248	
Persentage	82	84	82	82,67	

The validation of the material shown in Table 2 yielded values of 80% (very good), 86% (very good), and 82 (very good), with an average score of 82.67% (the average validator assessment), indicating that the material criteria are very good.

3.2 Kepraktisan Alat Peraga

An indicator of whether or not the use of teaching aids is good is to see and judge when they are used in the learning process. The data is to see the practicality of research on the use of these teaching aids when used in learning. Practicality data was obtained from observations made using observation sheets. The number of observations was carried out three times in each class (A and B), which became the study population class. The observers were lecturers in the course on hydraulics and pneumatics. The results of the study are in Table 3.

Table 3. Data from Research on the Practicality of Teaching Aids When Used by Lecturers

Meeting	Class	Indicator										Amount	Percentage
		1	2	3	4	5	6	7	8	9	10		
Meeting 1	class A	4	3	4	4	5	3	4	3	4	4	**38**	**76**
	class B	4	4	3	4	4	4	3	4	4	3	**37**	**74**
Meeting 2	class A	4	4	4	5	5	4	4	4	5	4	**43**	**86**
	class B	4	4	4	4	4	5	3	4	5	4	**41**	**82**
Meeting 3	class A	5	4	4	4	5	4	5	4	5	5	**45**	**90**
	clash B	4	5	4	4	5	5	4	4	5	5	**45**	**90**
Amount		**25**	**24**	**23**	**25**	**28**	**25**	**23**	**23**	**28**	**25**	**498**	
Presentation		**83,33**	**80,00**	**76,67**	**83,33**	**93,33**	**83,33**	**76,67**	**76,67**	**93,33**	**83,33**	**83,00**	

Based on the results of the study, the scores at meeting 1 on hydrostatic pressure material in class A were 76%, class B was 74%, meeting 2 on Pascal's law in class A was 86%, class B was 82%, and at meeting 3 on hydraulic working systems and pneumatics in class A were

90% and 90%, respectively. When viewed from each indicator, from 1 to 10, the highest score on indicators 5 and 9 is 93.33%, and the lowest score on indicator 3 is 76.67%, while the overall percentage value obtained is 83%. The value in the learning process using media teaching aids is declared to be very good.

3.3 Effectiveness In Terms of Student Activities

Observation sheets of activities carried out by students during the learning process with the use of teaching aids yielded research data on student activities. Students complete the observation sheet after following the learning process. Table 4 displays the results obtained from the effectiveness of students:

Table 4. Data on Effectiveness Results in terms of Student Activities

Class	Indicator										Amount	Percentage	Average
	1	2	3	4	5	6	7	8	9	10			
Class A	4	5	5	4	5	3	4	4	4	4	42	84	85
Class B	4	5	5	4	4	4	5	4	4	4	43	86	

According to the findings of research on the effectiveness of mechanical engineering students in classes A and B, they are classified as very good, as evidenced by the fact that the score for Class A is 84% (very good) and Class B is 86% (very good), with an average score of 85%. So it can be concluded that teaching aids in hydraulic and pneumatic courses are very well used in the teaching and learning process to improve the quality of science and knowledge of mechanical engineering education students.

3.4 Learning Outcomes Using Teaching Aids

The acquisition of learning outcome data in this study was obtained by giving tests to students, while the assessment results obtained are attached in Table 5, namely:

Table 5. Learning Outcomes

Class	Amount		Presenctage		Overall Percentage	
	Finished	Not Finisher	Finished	Not Finisher	Finished	Not Finisher
Class A	13	2	86,67	13,33	83,33	16,67
Class B	12	3	80,00	20,00		

The learning outcomes of mechanical engineering students using teaching aids media in class A are 86.67% complete with a total of 13 students, 13.33% incomplete with a total of 2 students, and in class B, the learning outcomes are 80% complete with a total of 12 students, and 20% incomplete with a total of 3 students. The number of students in class A and class B who obtained an average value of 83.33% for learning outcomes using teaching aids media demonstrates that the use of teaching aids media in the teaching and learning process of hydraulics and pneumatics is highly effective.

4 Conclussions

According to the research, the value of the validator's results for the construction of teaching aids media is 87.17% with a very good rating category, and the value of the material

for teaching aids media is 82.67%. According to the validator results, teaching aids media can already be used in the teaching and learning process. According to the findings of a study on teaching aid media used by lecturers in the automotive engineering study program, the average value of the practicality of using tools was 83%, with the criteria that it was feasible and very good to use, and an average of 85% in terms of student activities using teaching aid media. The learning outcomes of mechanical engineering students in hydraulic and pneumatic subjects obtained an average value of 83.33% based on the results of validators, user lecturers, and student activity assessments in the use of teaching aid media, implying that students get complete grades in hydraulic and pneumatic learning using teaching aids.

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References

[1] H. A. Latief, A. D. Herlambang, and T. Afirianto (2019). " Development of Flash-Based Learning Media on Network Design Subjects Class XII TKJ SMKN 2 Malang with Four-D Development Model, "Journal of Information Technology and Computer Science Development, vol. 3, no. 5. pp. 5096–5103.

[2] N. Wibowo. (2016). " Efforts to Increase Student Activity Through Learning Based on Learning Styles at Smk Negeri 1 Saptosari," *Elinvo (Electronics, Informatics, Vocat. Educ.*, vol. 1, no. 2, pp. 128–139, doi: 10.21831/elinvo.v1i2.10621.

[3] A. Djamaluddin and Wardana. (2019). *Learning and Learning 4 Pillars of Improving Pedagogical Competence*.

[4] A. Fatkhurrohman and J. Susilowibowo. (2019). " Development of video-based learning media using cartoon characters on transaction materials for manufacturing companies class X AKL SMK Negeri 2 Buduran," *J. Pendidik. Akunt. UNESA*, vol. 7, [Online]. Available: https://jurnalmahasiswa.unesa.ac.id/index.php/jpak/article/view/29772/27279

[5] S. H. Rizky Meuthia Karina, Alfiati Syafrina. (2017). " The Relationship Between Interest in Learning and Student Learning Outcomes in Science Subjects in Class V Elementary School Garot Geuceu Aceh Besar," Ilm. Educator. School Teacher. Base, vol. 2, no. 1, pp. 61–77.

[6] R. S. Tiara Dewi, Muhammad Amir Masruhim. (2016). " Factors Causing the Decline of Student Learning Outcomes in Sociology Learning in High Schools," Lab. researcher. and Pemb. Trop Pharmacy. Fac. Farms. Univ. Mualawarman, Samarinda, East Kalimantan, no. April, pp. 5–24.

[7] R. S. Waddi Fatimah, Perawati Bte Abustang. (2022). " The Influence of Learning Interest on Social Studies Learning Outcomes," J. Kaji. Educator. Base, vol. 7, no. 1, pp. 28–35.

[8] "1999-Article Text-5032-1-10-20220517.pdf."

[9] W. Pendidikan. T. Otomotif, F. Keguruan, and P. Hidraulik. (2020). " Automotive Engineering Education Study Program Students," vol. 15, no. 01, pp. 1–7.

[10] P. Priyonggo. (2013). " Improving Understanding of Pneumati and Hydraulic Course with The Help of Macro,edia Flash MX Movie Clip Multimedia and Model Framework Form:," no. 1, pp. 74–84.

[11] D. Widjanarko. (2014). " Motor Starter Inspection And Troubleshooting Type," vol. 3, no. 2.
[12] S. Anwar, S. Soeryanto, D. Suwito, and A. P. Budijono. (2020). Development of Problem-Based Pneumatics & Hydraulics Learning Devices Oriented Work Ready Skills," *Journal of Vocational and Technical Education (JVTE)*, vol. 2, no. 2. pp. 18–28, doi: 10.26740/jvte.v2n2.p18-28.
[13] A. Dewanto. (2-15). Learning Hydraulic and Pneumatic Systems Using Automation Studio," Journal of Technology and Vocational Education *UNY*, vol. 21, no. 3. p. 163857.
[14] P. T. Otomotif, J. T. Mesin, and F. Teknik. (2020). Development of E-Module Media to Improve The Competence of Understanding Heavy Equipment Hydraulic System for Students of SMKN 1.
[15] Aslizar, Danar Susilo, Basori (2017) .*The use of learning media with teaching aids to improve learning outcomes in the subject of engineering drawing*. Jakarta, Eleven Maret University
[16] Yondi Pramanta (2020). T*he Effect of Using Motorcycle Engine Teaching Aids on Learning Outcomes of Class XI Students of SMK N 1 Airmadidi*