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Development of a BLDC (Brushless DC) Media Trainer for Learning Working Principles of Electric Vehicle Motors

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ABSTRACT
This study aims to 1) produce learning media in the form of trainers that can be used in automotive electricity courses in the form of using BLDC (Brushless Motor DC) motors, 2) determine the level of feasibility and student response to the use of BLDC media trainers. The research method used is the development method (R & D) with five stages that will be carried out in the research process to produce products and test the effectiveness of these products. The five stages of the research are analysis carried out based on the results of observations in the field with reference to the conditions of teaching and learning activities and student activities. After getting information from the observations, the next step is the design of trainers that suit the needs of students, especially the selection of interfaces that suit their needs and are updated. In the next stage, trainer development is carried out by making instructions for use and validating the created media trainer. If the media trainer has been made, it will be tested directly on students regarding the ease of using the trainer as well as to find out the effectiveness of the BLDC control media trainer. distributing questionnaires to determine the quality of the model that has been implemented. The focus of the research was the BLDC trainer-based learning model for the Automotive Electrical subject and the research subjects were 30 students majoring in Automotive Engineering Education, Faculty of Engineering, Makassar State University. The results of this study indicate that the BLDC control media trainer developed on media and material aspects is in a very valid category to be used. The implementation of the media trainer received student responses which were in the very practical category in its use and the results of student test scores after implementation had increased to the high category. The conclusion of the data stated that the BLDC control media trainer that had been developed was stated to be valid/feasible to use as well as practical and effective in its use.

Keywords: *Learning Media, BLDC Motor Trainer Media, Electric Vehicles.*

1. INTRODUCTION

Learning in tertiary institutions can face several problems that affect the effectiveness and quality of the learning process. Some of the common problems in college learning is the lack of Student Engagement: One of the main problems is the lack of active involvement of students in the learning process. Students can be passive in receiving information without developing a deep understanding. This can be caused by teaching methods that are less interactive, curricula that are too focused on theoretical knowledge, or a lack of internal motivation from students. Ineffective Teaching Methods: Ineffective teaching methods can be a hindrance in college learning. Teaching approaches that are too focused on lecturing or transferring information can make students lose interest and opportunities to participate actively. Teaching methods that are not diverse and pay little

attention to individual learning styles can also hinder student understanding and involvement as well as, evaluations that do not reflect actual learning: Evaluation systems that focus too much on written tests and end-of-semester assessments often do not reflect actual understanding and skills. by students. This can produce high pressure on students to study only for exams, not to understand in depth the learning material.

Lack of Collaboration and Discussion: Lack of opportunities for collaboration and discussion in the learning environment can also be a problem. Group discussions, collaborative projects, or interactions with fellow students can improve understanding, critical thinking, and problem solving. However, in some cases, a congested curriculum or large class sizes can hinder the possibility of effective collaboration. Technology and Access Challenges: Advances in technology have brought about major changes in higher education learning, but they can also cause challenges. Not all students have equal access to the technology and internet access required for online learning or the use of digital resources. This can produce gaps in student learning and participation. Universities should be aware of these problems and work to address them by adopting more interactive teaching methods, building collaborative environments, and integrating technology wisely. In addition, continuous formative evaluation and a variety of evaluation methods can provide a more holistic picture of student progress [1].

Learning media in tertiary institutions is an important component in designing and delivering learning materials to students. This creates an opportunity to introduce the topic, provide an overview, and build the necessary knowledge base before moving into more in-depth material. Interesting media can attract students' attention and arouse their interest in the topic to be discussed. This can be achieved by using illustrations, practical examples, interesting facts, or relevant stories to pique student interest and curiosity [2].

The BLDC (Brushless DC) Media Trainer is a learning tool specifically designed to learn the working principles of electric vehicle motors using BLDC motors. This Media Trainer provides practical experience to users in understanding how a BLDC motor functions and interacts with the control system. This BLDC Media Trainer enables users, such as students or professionals in the engineering or automotive fields, to gain a deep practical understanding of the working principles of BLDC motors and related control systems. With safe experiments and simulations on Media Trainer, users can develop the skills and knowledge needed to design, repair, or optimize electric vehicle motor systems that use BLDC motors [3].

2. RESEARCH METHODS

The research method used is Research *and Development* (R&D) using the 4D model. The 4D research method is a research approach that refers to four dimensions, namely *Define, Design,* Develop, and Deploy. This method is often used in the context of technology development and implementation, particularly in the field of information systems or information technology. Data collection techniques in this study were through observation, interviews, and questionnaires [4] . The research was conducted at the Department of Automotive Engineering Education, Faculty of Engineering, Makassar State University, involving 60 students who had programmed an automotive electricity course and a lecturer for the course as research subjects and a research trial group. The research process consists of several stages, namely: 1) *define:* this dimension focuses on identifying and gathering initial information about the problem or need to be resolved, as well as formulating research goals and objectives. This step involves initial analysis, data collection, and identification of problems to be investigated in the bldc motor trainer work system learning media. 2) *design:* after the problem or need is defined, the next step is to design a solution or concept to be developed. In this dimension, the researcher designs the desired concept or solution design, including technical specifications, features, and system architecture to be developed on the bldc motor trainer work system learning media. 3) *develop:* after designing a solution concept, the next step is to develop the system or technology. This dimension involves implementing, testing, and developing prototypes or system models that have been previously designed on the bldc motor trainer work system learning media. 4) *deploy:* after the system or technology has been developed and tested, the last step is to implement it in the relevant environment. This dimension involves implementing a system or technology into a real environment, evaluating, and measuring system performance, as well as adjusting and improvements if necessary to

the bldc motor trainer work system learning media [5].

Table 1. Research Instrument

No.	Assessment Aspects	Indicator	grain
1	Media presentation	Media relevance	1, 2, 3, 4
		Language in media delivery	5, 6, 7, 8, 9
		Measurement Easy to understand	10, 11
	Media/Display	Display Box	1, 2,
		Text Instructions for Use	3, 4
		Pictures and Media Illustrations	5, 6, 7, 8, 9
		Media Presentation	10, 11, 12
	Benefit	Teaching and learning activities	1, 2, 3, 4
		Interest in Media	5, 6

Table 2. Validation Sheet

No		Validation Sheet
1	a.	Instructions for teaching media assessment are clearly stated
	b.	The criteria are clearly stated
2	a.	Indicators are clearly stated
	b.	Statement items according to indicators
3	a.	Using standard Indonesian
	b.	The language used is easy to understand
	c.	Language does not have a double meaning

Data formula per item

$$P = \frac{X}{X_1} \; x \; 100\% \qquad (1)$$

Information:

P = percentage

X = respondent's answer in 1 item

X_1 = total ideal score in 1 item

100% = constant

The formula for processing data as a whole item

$$P = \frac{\sum \; x}{\sum \; x_1} \; x \; 100\% \qquad (2)$$

Information:

P = Percentage

$\sum \; x$ = The total number of respondents' answers

$\sum \; x_1$ =The total ideal score in one item

100% = constant

To determine the criteria, do the following:

Table 3. Assessment Criteria

Category	Percentage Score (%)	Interpretation	Equivalent
A (4)	80% - 100%	Very good	Worthy
B (3)	60% - 79%	Good	Pretty decent
C (2)	50% - 59%	Pretty good	Not worth it
D (1)	0% - 49%	Not good	Not feasible

3. RESULTS AND DISCUSSION

A. *Define _*

Based on the results of questionnaires, observations and interviews with students and lecturers in charge of automotive electricity courses, there is still minimal media that can be taught to students regarding knowledge of using sensors on motors/dynamos of current electric vehicles so that researchers get information to develop a work system media trainer on bldc motors, where this bldc motor is a type of motor that is often used for electric vehicles. This media will be made based on developments in the world of education and the ability of students to understand current automotive electronics technology [6]. Teaching media must be presented in an attractive way so that students are more enthusiastic in learning and able to understand the material provided. One solution to overcome this

problem is to use learning media in the form of media that is packaged in a digital system that is integrated with each other in the form of hardware that can help students understand and develop ideas on the performance of bldc motors in the use of electric vehicles [7]. Practicum is expected to be learning that can be mastered by students after completing practicum learning activities during the development of automotive electronics technology.

B. *Design _*

The planning process involves making a learning media design for trainer work systems based on the material used in learning and the results of initial observations that have been made in the Department of Automotive Engineering Education, Faculty of Engineering, UNM [8]. The results of this design stage include electronic circuits, media boxes, support programs, learning modules, and trainer work system job sheets. The development stage involves the creation of trainer work system learning media based on the designs that have been made, which consists of two stages, namely the creation of learning media based on the designs that have been made and the development of media programming that is adapted to the abilities of students based on initial observations, as well as learning competency criteria and indicators to be taught. The following are the results of designing a learning media device for a trainer's work system [9].

C. *Develop _*

In the process of developing trainer work system learning media, researchers conduct material studies by collecting references and relevant circuit paths. References used include reference books and scientific articles [10]. The researcher proceeded to the development stage by discussing and consulting with the subject lecturer. Media assessment is carried out by involving expert validators in the field of trainer work system learning media [11].

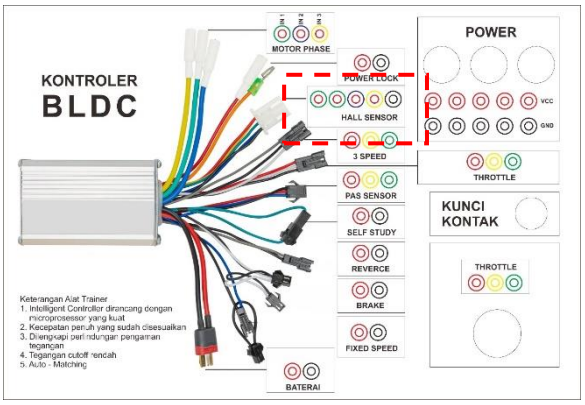

Figure 1. Schematic of the Media Series

Figure 2. BLDC Motor Working System Media

Questionnaire validation results before researchers collect data through group trials starting from *one to one* , small groups and field tests, the total score for the expert validator the first is the value of 11 out of 12 (percentage 91.67%) and is included in the very valid category. The second validator gave a total score of 12 out of 12 (100% percentage) and was included in the very valid category. The average score of the two validators was 11.5 out of 12 (percentage 95.83%) and it can be concluded that the instructions for filling out the questionnaire stated by the two validators were very valid **.**

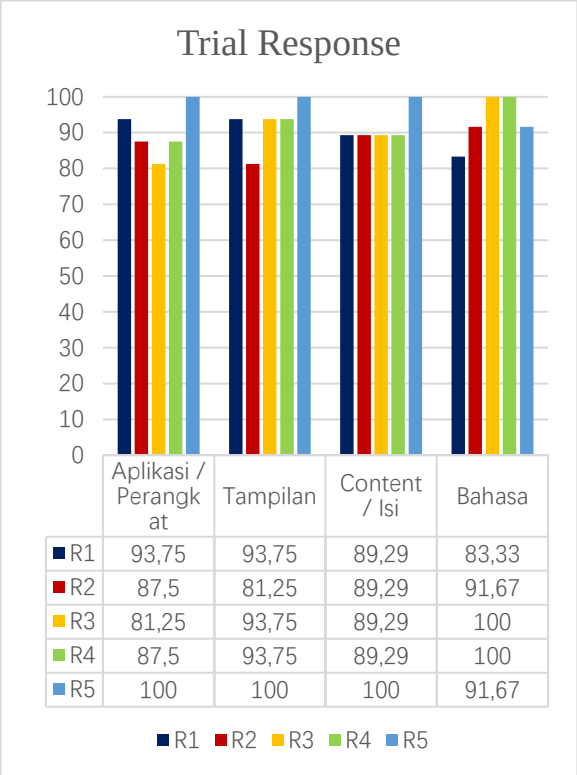

Figure 3. Test Results

D. *Deploy* _

The application of development results is carried out in learning to evaluate the effectiveness, attractiveness, and efficiency of the development of learning media that has been carried out. However, in this study, the implementation phase was not fully carried out because the research only reached the formative evaluation stage, namely making improvements to product development [12,13].

Expert validation percentage formula, namely

$$P = \frac{\sum \quad X}{\sum \quad X_1} \; x \; 100\%$$

$$P = \frac{143}{156} \; x \; 100\%$$

$$P = \; 91.66\%$$

Based on the results of the expert's assessment of the material listed there are 3 aspects of the assessment, namely aspects of content feasibility, presentation feasibility, and language feasibility. The material expert's assessment of the feasibility aspect of the contents of each statement received a score of 3 and 4 which indicated the feasibility of the content of the trainer's work system media was rated in the good category. Assessment on the feasibility aspect of presenting the statement gets a score of 4 and 3 which indicates that the presentation aspect of the trainer's work system media is rated in the good category. Assessment on the aspect of language feasibility, each statement gets a score of 3 and 4 which indicates the feasibility of the media content of the trainer's work system is rated in the good category. From the three assessment aspects, a calculation of 91.66% is obtained, indicating that the success rate is in the very good category [14,15].

Based on the test results, the highest score obtained in the pretest was 66.67 with an average student score of 47.01, and in the posttest the highest score was 96.6 with an average student score of 79.82. From these data, the N-Gain value can be calculated as follows.

$$N_{Gain} = \frac{Postest - Pretest}{Maximum - Pretest} \qquad (3)$$

$$N_{Gain} = \frac{87{,}1 - 43{,}8}{100{,}0 - 43{,}8} = 0{,}77$$

Based on the results of these calculations, the N-Gain value is 0.77 or in the high category, so it can be concluded that the working system media trainer on BLDC motorbikes has been effective in its use.

4. CONCLUSION

1. The development of trainer work system media was developed using 4 stages using *Research and Development* (R&D) research with a 4D model. The 4D research method is a research approach that refers to four dimensions, namely *Define* (Define) where researchers analyze the needs of the importance of developing , *Design* (Designing) researchers carry out media designs trainer work system along with tools related to media , *Develop* (Develop) researchers ensure that the products developed are suitable for use or tested in the field based on expert judgment , and *Deploy* (Implement) researchers implement products that have been designed and have been

feasible for students to be able to obtain data on the practicality and effectiveness of media use.

2. trainer work system media product has been declared valid or feasible to use as evidenced by the assessment of two experts with the results of a feasibility percentage of 93.13% for media eligibility and 93.41% for material eligibility. The trainer work system media product has been declared practical in its use as evidenced by the very high assessment data by students from 3 trials with the results of the practicality percentage of one to one test of 88.49 %, small group 91.82 %, and finally in the group large get the percentage of 92, 71 % .
3. trainer work system media product has been declared effective as evidenced by learning outcomes that increased from an average score before use *(pretest)* of 43.8 to an average score after use, namely 87.1 with an *N-Gain* of 0.77 or in the category tall.

REFERENCES

[1] Arifin, Z. (2016). Development of Microcontroller Trainers and Jobsheets as Learning Media in Control System Engineering Subjects in the Industrial Electronics Department of SMK Negeri 1 Bangil. Journal of Electrical Engineering Education.

[2] Bayu, DS (2014). ATmega16 Microcontroller Trainer as Learning Media at SMK N 2 Pengasih. Journal of Electrical Engineering.

[3] Hariyadi, A., & Kholis, N. (2015). Development of Microcontroller Trainers as Learning Media at State Vocational School 1 Sidoarjo. Journal of Electrical Engineering Education.

[4] Alam, M. K., Ab Rahman, S., Mustafa, H., Shah, S. M., & Hossain, M. S. (2019). Shariah governance framework of Islamic banks in Bangladesh: Practices, problems and recommendations. *Asian Economic and Financial Review*, *9*(1), 118.

[5] Madhawirawan, AF (2010). Atmega32 Microcontroller Trainer as Learning Media in Class Xi of the Audio Video Expertise Program at SMK Negeri 3 Yogyakarta. Yogyakarta State University.

[6] Nurmadiah, N. (2016). Educational Media. Al-Afkar : Journal of Islam & Civilization. https://doi.org/10.28944/afkar.v5i1.109

[7] Nurseto, T. (2012). Making Interesting Learning Media. Journal of Economics and Education. https://doi.org/10.21831/jep.v8i1.706

[8] Sumiharsono, M Rudi., & hasanah, Hisbiyatul (2018). Instructional Media. Immortal Library CV. Jember.

[9] Device, P., Ipa, P., & Di, T. (2012). Journal of Innovative Science Education. Journal of Innovative Science Education.

[10] Rahmadiyah, I., & Sumbawati, M. (2014). Development of Digital Electronics Trainer Learning Media for Basic Electronics Engineering Subjects. Journal of Electrical Engineering Education.

[11] Yaumi, Muhammad, (2018). Learning Media and Technology. Prenadamedia Group. Jakarta.

[12] Riyana, Cepi. (2012) Learning Media. Directorate General of Islamic Education, Ministry of Religion.

[13] Wicaksono, AH, & Pramono, HS (2016). Development of Sensor KIT Trainers as Learning Media for Sensor and Actuator Subjects at SMK Negeri 2 Pengasih. Yogyakarta State University E-Journal.

[14] Stewart, H., Gapp, R., & Harwood, I. (2017). Exploring the alchemy of qualitative management research: Seeking trustworthiness, credibility and rigor through crystallization. *The Qualitative Report*, *22*(1), 1-19.

[15] Islam, M. A., & Aldaihani, F. M. F. (2022). Justification for adopting qualitative research method, research approaches, sampling strategy, sample size, interview method, saturation, and data analysis. *Journal of International Business and Management*, *5*(1), 01-11.