The Interactive Multimedia Learning for Power Electronics Course

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Krismadinata[1](✉), Ulfa Isni Kurnia[2], Rudi Mulya[2], Unung Verawardina[2]
[1] Centre of Energy and Power Electronics Research (CEPER), Universitas Negeri Padang, Padang, Indonesia
[2] Universitas Negeri Padang, Padang, Indonesia
krisma@ft.unp.ac.id

Abstract—The main problem in learning power electronics course is that there are many things that require imagination to understand the principles of power converters. Thereto, learning that occurs is not flexible, which only occurs in the classroom, even though students need a lot of time to understand the material and need media that is able to visualize through illustrations, text, pictures, audio. This paper proposes the development media in the form of Power Electronics Learning Interactive Multimedia Courses which were developed using the help of the Adobe Flash application, so it is hoped that with this media students can learn the material of DC-DC converters and AC-AC converters easily, and can learn flexibly. Therefore, this study aims to develop a learning media that can overcome these problems, in the form of Interactive Multimedia Learning for Power Electronics Courses, which was developed using the help of Adobe Flash applications. The research method used refers to the Instructional Development Institute (IDI) model. The results of this study indicate that the Interactive Multimedia Learning for Power Electronics Course can be successfully used in learning. Meanwhile, the novelty of these findings makes a different contribution from previous interactive multimedia learning, because through media development you can learn with multimedia elements that describe DC-DC converters and AC-AC converters online so that learning becomes more flexible.

Keywords—power electronics, interactive multimedia, e-learning

1 Introduction

Facing 21st-century learning, the development of technological advances has created more interesting and effective learning in the context of teaching and learning. This results in educational innovation that encouraged more creative development for various interactive technologies [1]. The use of multimedia-based technology is increasingly popular in many fields of learning and training because it stimulates new ways of delivering information with attention to accessibility, repeated use, and individualization to meet the needs of various types of students. Multimedia has introduced pedagogues' power in facilitating student learning and completing the learning

with activities because it enriches meaning in the presentation of information by using more than one media [1]; [2]; and [3]. Computers are a type of media that can virtually provide an immediate response to student learning outcomes [4].

Through the use of interactive multimedia, there are elements of animation so that it can clarify the concept of visualization of teaching materials [5]; [6]; [7] and fun learning [8]. Multimedia mediated content which is incorporated into the learning environment, contains information-rich presentation that makes learning instructions more effective rather than a presentation through a single medium in memorization, in this way, students can obtain more meaningful and repetitive information through various media and choices [9]; [10]; [11]. Interactive multimedia presentations consist of different media with a temporal and spatial synchronization that can be navigated via hyperlinks [12].

Students need to be able to study flexibly by being able to determine their own time and the information they want to learn. The integration of multimedia content has become an important part of the current electronic learning system. This section proposes the development of media for the design and integration of multimedia content in e-learning based learning systems-learning is online learning.

It is a learning system that enables students to learn anytime and anywhere - flexibly, so that learning can take place inside and outside the classroom [13]; [14]; [15]; [16]; [17]; [18]; [19]. The excellence of online learning is that it makes teachers/lecturers have plenty of time to provide feedback about students' improvement outside of class hours [20].

One important element in the development of e-learning Learning is the availability of study guides. Every successful Electronic Learning must include a study guide that covers the course objectives, list of resources needed to complete the course [21]. To encourage the use of e-learning infrastructures fosters teaching and learning in the university [22]; [23].

Based on the results of observations made on the educational process in the Electrical Engineering Education Study Program, in Universitas Negeri Padang (UNP) in Power Electronics course, students still lack understanding of DC-DC converter and AC-AC converter materials as these materials require high imagination to be able to fully understand them moreover, the material is abstract. But in the learning process, the lecturer only explains the concepts through lectures and the media used by the lecturer is only displaying pictures on the blackboard and slide shows. In addition, there is also a time constraint in the learning process that causes the delivery of material to become incompletes. Figure 1 shows power electronic devices for the learning process power electronics course.

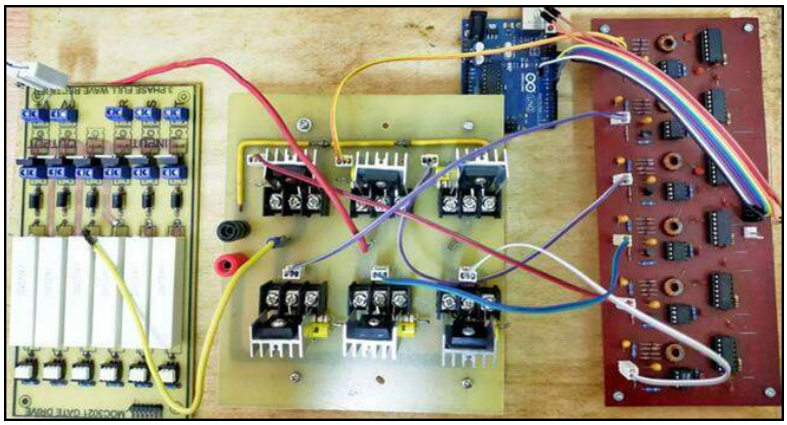

Fig. 1. Semiconductor power component concept map

The presentation of material that is like in the picture above makes students bored in the learning process. This is evident from the learning process that shows many students are busy with their activities such as using a smartphone, drawing, and using a laptop but are not looking for references to ongoing learning material. Things like this make students do not understand the material presented by the lecturer.

Power Electronics is one of the mandatory courses for electrical students because Power Electronics is widely used in the industrial world. Power Electronics course subject is divided into two courses, namely theory and practice. Competencies that must be possessed by students after completing the course are that students should be able to understand and explain the concept of power electronics. Another provision to help students to improve their understanding of this course is a practical subject. However, in the learning process, there are still many problems found such as limited time allotment and traditional learning methods [24]; [25]; [26]; [27]; [28].

Another problem is that there are still many students who do not understand the material being taught and are less active in the learning process. Besides, low student learning outcomes for Power Electronics courses also become a problem that needs to be addressed and solved [29]. One of the solutions to the above problems is done by developing an interactive multimedia-based learning media.

Students' understanding can be improved by innovating in the learning process. The learning process is essentially a lecturer communication process when delivering information to students. The information conveyed can be in the form of pictures, symbols, sequences, or logic that will be captured by students. Information that can be conveyed effectively certainly requires adequate media. The world of education continues to move dynamically, especially to create media that are increasingly interactive and comprehensive. The media that is widely used today is learning media based on Information and Communication Technology (ICT). ICT has broad benefits to make it easier to deliver teaching materials. Interactive multimedia-based learning media can be created by using Adobe Flash CS6 software because Adobe Flash CS6 has several advantages in which it can be equipped with several kinds of animation that is more flexible and learning media [made from this application] can be accessed

both online and offline. One of the researchers who developed multimedia-based learning media on power electronics is [30], the results found to have a weakness, namely interactive multimedia-based learning media cannot be accessed online.

2 Methods

This study used the R & D research method by adopting the Instructional Development Institute model through the stages of defining, developing, and evaluating [31]. Following the flow of media development can be seen in Figure 2.

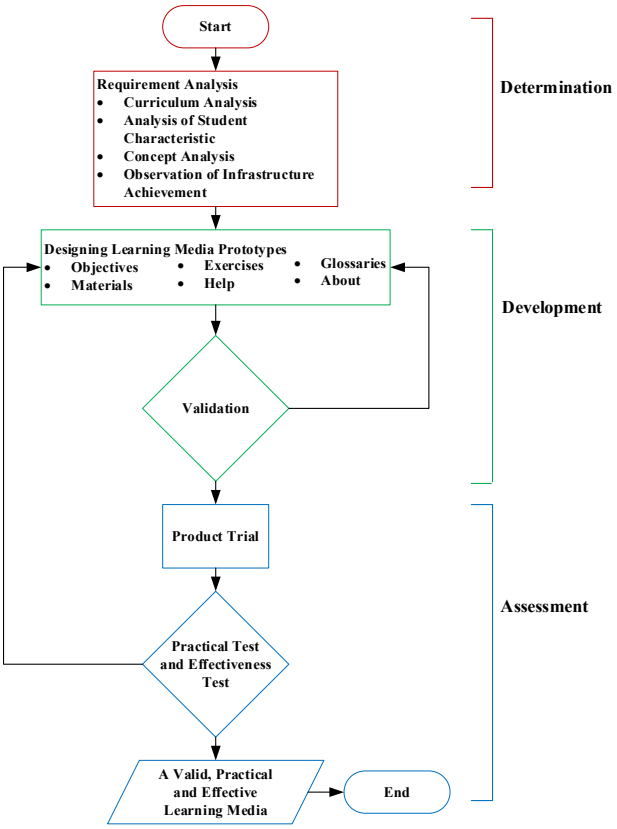

Fig. 2. Flowchart of media development

The research subjects were 43 students who take Power Electronics courses in the 2018/2019 academic year. The instrument used was a questionnaire to measure the validity of Interactive Multimedia media which was assessed by media experts, the aim was to find out whether the media was valid or not. In addition, questionnaires were also used for practicality tests to determine the ease and usefulness of Interactive Multimedia which was assessed by students and lecturers. Then the measurement is

used to determine the effectiveness of Interactive Multimedia as seen from the learning outcomes of the Power Electronics Course. The data analysis technique used was descriptive. The sample in this study to measure validity is a media expert, a material expert. Samples for practicality are lecturers and students. The sample to test the effectiveness of the media is students of UNP. The Interactive Multimedia media is applied in learning by giving experiments to students, then giving a learning outcome test.

3 Results and discussion

3.1 The define results

The developed interactive multimedia-based learning media is a learning media on DC-DC converter and ACAC converter material in the form of files with 2 formats, exe, and swf. This learning media can be accessed online and offline by students. Students access the learning media through the UNP e-learning portal. The online learning media used the swf format and the offline learning media used the exe format.

The purpose of this learning media is as a tool for lecturers to convey information to students so that students will be able to actively learn, participate and interact during the teaching and learning process. The benefits of this learning media for students are to improve students' understanding and motivation when learning the material taught. The following are the results of the development of interactive multimedia-based learning media.

The defined results at the defined stage need analysis for the development of this learning media was carried out, some of the needs analyses that were done are student's characteristics analysis, curriculum analysis, concept analysis, and facility and infrastructure analysis. Analysis of the student's characteristics, Electrical Engineering Education students, reveals that the Study Program has more high school graduates than vocational high school therefore many students are still waiting for information/ knowledge from the lecturer. The curriculum analysis refers to semester learning plans and the Teaching Outlines of power electronics course subject. Students must have the competence to understand and explain the concept of power electronics.

The concept analysis aimed to determine the content and subject matter needed on the material of DC-DC converter and AC-AC converter to develop this learning media. The data for facilities and infrastructure analysis were taken from the UNP e-learning portal. The learning media used the swf format but upload the teaching material on the e-learning portal – since it does not support the swf format so the material was uploaded in the Google Drive and Google site and linked to the UNP e-learning portal. Google drive is used to download the learning media and open it offline while Google's site is used to access the learning media online. Furthermore, Lecturers must ensure that the computer device is functioning properly so that they can run the media online and offline.

3.2 The Development results

a) Page Display of Menu in the interactive multimedia-based learning media contains DC-DC converter and ACAC converter materials in the material menu – there will be a sub-section about the details of DC-DC converter and AC-AC converter. On this page, there are 6 navigation buttons as learning objectives button, glossary button, material button, exercise button, video button, and the help button, and about button. The following is the main page of the Converter Material Media can be shown in Figure 3.
b) Page Display of learning objectives is used to go to the learning objectives page that contains the learning targets to be achieved. Figure 4 shows the learning objectives of the materials.
c) Page Display of material contains material from power electronics, on the material page, the DC-DC converter and AC-AC converter theories are explained in a language that is easily understood by students, therefore the students can understand the concepts of DC-DC converter and AC-AC converter easily. Figure 5 shows selected material of power electronic course. Meanwhile, Figure 6 is shown the Content of Material Selection Page, and Figure 7 can be shown the Converter Exercise Questions Page.
d) Page Display of video contains videos related to learning material in using the power electronics application can be shown in Figure 8.
e) Display Page of help contains information on how to use the power electronics application if a user is in doubt when running the power electronics application and Page Display of glossary contains terms and meanings that are not yet known or already known of students in using the power electronics application can be shown on Figure 9.

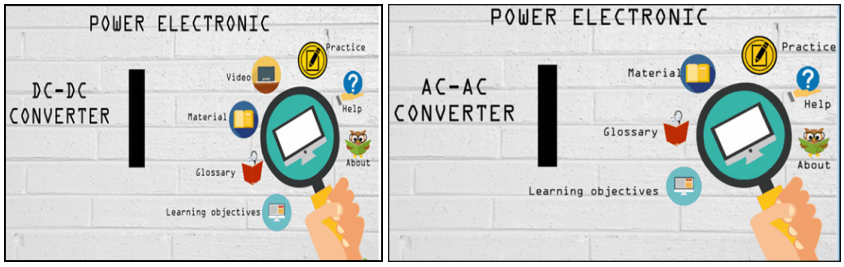

Fig. 3. The main page of the media

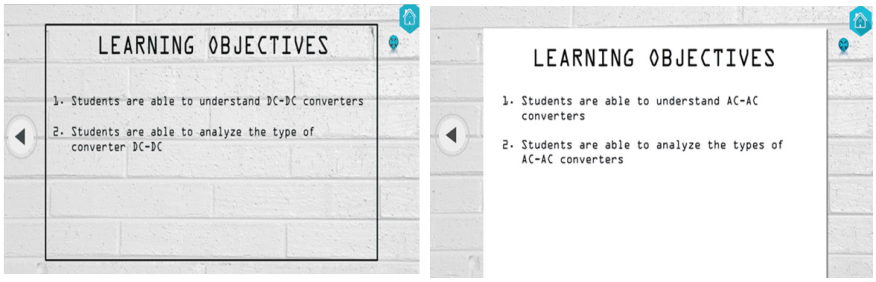

Fig. 4. Learning objectives

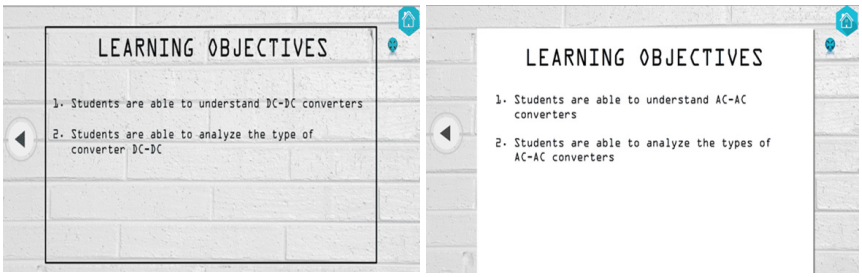

Fig. 5. Material selection page

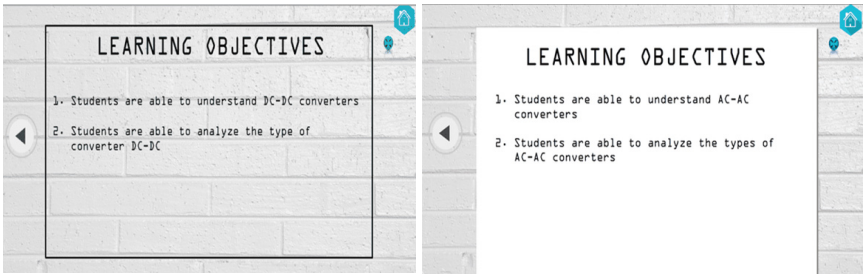

Fig. 6. Content of material page

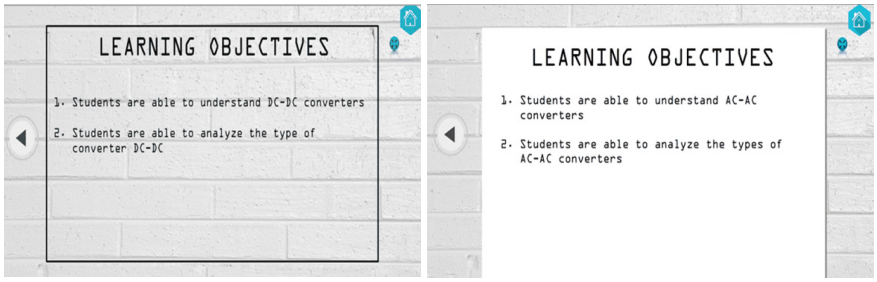

Fig. 7. Converter exercise question page

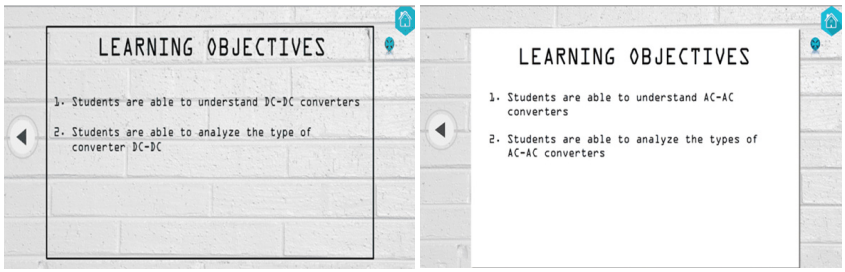

Fig. 8. Video of converters on the display page

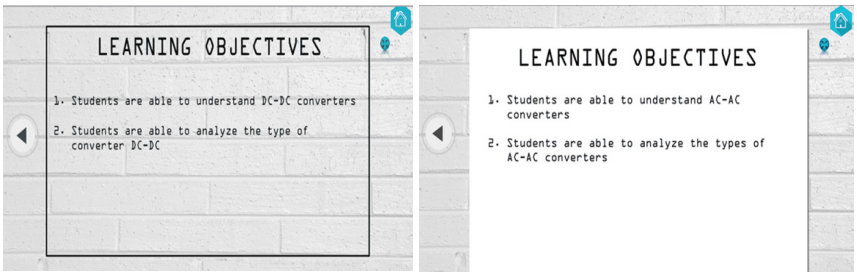

Fig. 9. AC-AC converter material selection page

3.3 The Evaluate results

The validation of learning instructional media is a validation of the resulting product design. The results of material validation and design validation are shown in Figure 10. The validation results from validator 1 and validator 2 are respectively 0.83 and 0.82 with an average of 0.82 which falls in the valid category. Meanwhile, design validation results from validator 1 and validator 2 are respectively 0.82 and 0.79 with an average of 0.80 which falls in the valid category.

In the evaluation stage, the practicality and effectiveness of the learning media were evaluated. There are three practical aspects of learning media based on the lecturer's responses and students' responses through questionnaires. The assessment results of the practicality of the learning media are summarized in Figure 11. It can be seen that there are three practical aspects of learning media based on the lecturer's responses through questionnaires. The average percentage is an assessment from the two practitioners. The three practical aspects are (1) technical use which obtained 100% in the very practical category, (2) Time content which obtained 86% in the very practical category, (3) design which obtained 85% in the very practical category. All these three aspects obtained an overall average of 89% with a very practical category. These results indicate that the learning media developed facilitates lecturers in helping students to improve their understanding.

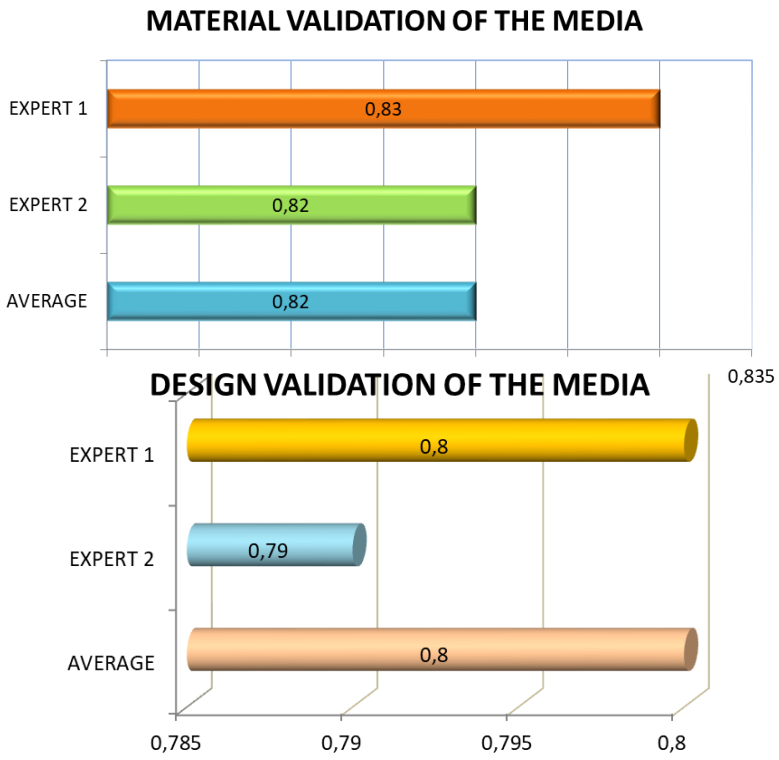

Fig. 10. Results of material validation and design validation

The results of student practicality aim to improve the performance, attractiveness, and usability of the media by filling out a practicality questionnaire. It can be seen that there are 3 aspects of learning media practicality based on student responses through questionnaires. The average percentage is an assessment from students which includes: (1) The ease of use of the learning media which obtained 84% with a very practical category, (2) The attractiveness of the learning media which obtained 86% with a very practical category, (3) In the usefulness aspect of learning media, it is obtained 85% in the very practical category. All these three aspects obtained an overall average of 85% with a very practical category. These results indicate that the practical categories developed help to facilitate students in understanding the material.

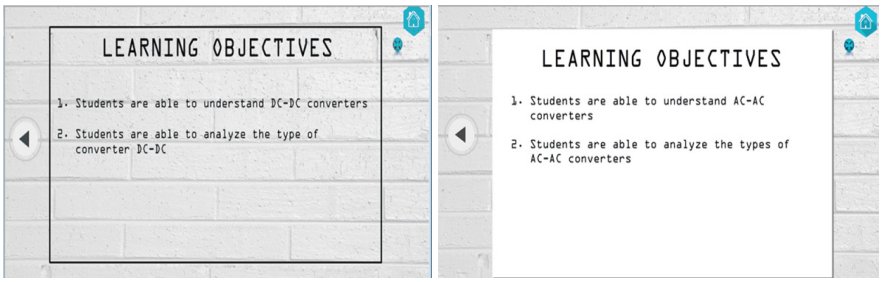

Fig. 11. Results of lecturers practically and student practicality

3.4 Evaluating result

The effectiveness test was seen from student learning outcomes before using the learning media pre-test which obtained an average value of 59 and after using the learning media post-test which obtained an average value of 81. Judging from the gain score – the increase in pretest and posttest is 0.50 on the intermediate category. Figure 12 shows a histogram of pre-test and post-test using the learning media.

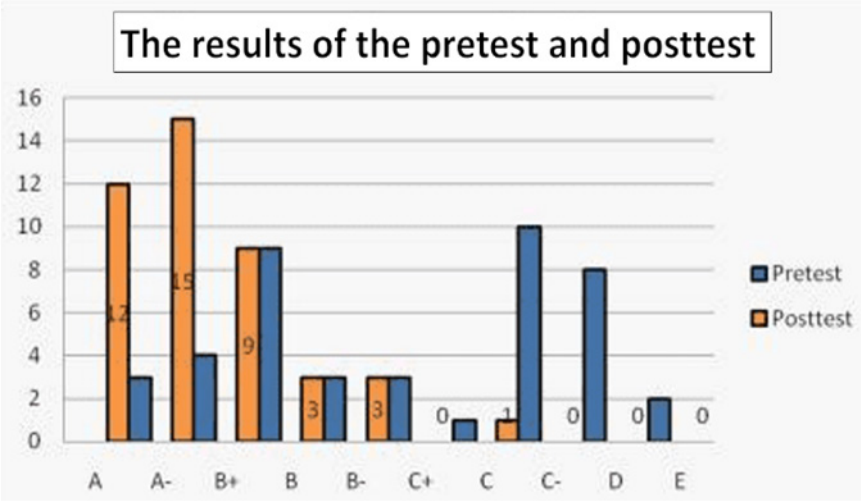

Fig. 12. Histogram pretest and posttest

The effectiveness of the interactive multimedia-based learning media was tested again with an effect size of 1.8 with a large category. The effectiveness of the learning media was also seen from the learning motivation of students who used the interactive multimedia-based learning media. The results of this study, in line with 's [24]; [23] research on Learning Reading Skills Independently Using Interactive Multimedia, show that multimedia can affect the teaching and learning process . In addition, the findings of [32] are packaged in multimedia-based learning media visual software that can motivate students to understand the material. So it is concluded that interactive

multimedia has a good impact on learning outcomes and student motivation in learning.

4 Conclusion

This interactive multimedia-based learning media that has been developed contains material for electronics courses, especially material for DC-DC Converters and AC-AC Converters. The media contains illustrations of text, images, audio, and visuals. The media can be accessed flexibly. It was presented that multimedia-based learning media were declared valid by media experts and material experts. For practical results for lecturers and students that include practical aspects, attractiveness and use are classified as very practical so that the learning media developed can be used in the teaching and learning process. In addition, the results of the effectiveness test based on the results of the pretest and posttest showed that the learning media category developed was categorized as moderate to help improve student learning outcomes and motivation.

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7 Authors

Krismadinata was born in Padang Indonesia. He received the B.Eng. degree from Universitas Andalas, Padang, Indonesia, in 2000 and the M.Eng. degree from the Institute of Technology Bandung, Indonesia, in 2004 and the Ph.D. degree from the University of Malaya, Kuala Lumpur, Malaysia, in 2012, and Post-doctoral at UMPEDAC within 2012-2014. He was one of awardees ASEAN-INDIA Research Training Fellowship in 2019. He is currently with the Department of Electrical Engineering, Universitas Negeri Padang, where he is also a professional engineer and the Director of Center for Energy and Power Electronics Research Universitas Negeri Padang. Dr. Kris has international patents and also as reviewer for many international journals in electrical engineering and energy fileds. He is actively involved in consulting on renewable energy projects. His research interests are power electronics, control system and renewable energy.

Ulfa Isni Kurnia is a student Magister at Department of vocational technology education Faculty of Engineering, Universitas Negeri Padang.

Rudi Mulya is a Ph.D at Department of vocational technology education Faculty of Engineering, Universitas Negeri Padang. He received the B.Eng. degree from Departement of Electrical Engineeing Universitas Andalas Padang in 2008 and M.Com degree from UPI YPTK Padang Indonesia in 2013 and 2018 respectively

Unung Verawardina is a Ph.D at Department of vocational technology education Faculty of Engineering, Universitas Negeri Padang.

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