Multimedia Simulation Model on Basic Electricial and Electronics Subjects for Vocational Secondary School

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A R T I C L E   I N F O

A B S T R A K

Kondisi pembelajaran di masa pandemi ini membatasi pertemuan langsung guru dan siswa. Pembelajaran online di SMK memiliki beberapa kendala, seperti media pembelajaran yang kurang tepat sehingga berdampak pada hasil belajar siswa. Penelitian ini bertujuan untuk menghasilkan suatu model simulasi produk multimedia pada mata pelajaran Elektro dan Elektronika Dasar di SMK. Jenis penelitian ini adalah pengembangan. Penelitian ini menggunakan model pengembangan Bergman & Moore. Uji kelayakan diperoleh berdasarkan studi ahli yang dilakukan oleh ahli materi dan ahli media dan desain pembelajaran. Teknik pengumpulan data menggunakan instrumen evaluasi formatif. Pengembangan produk ini menggunakan teknik analisis data kuantitatif dan teknik analisis data kualitatif. Instrumen yang digunakan untuk mengumpulkan data adalah kuesioner. Hasil uji kelayakan menunjukkan bahwa multimedia dengan model simulasi yang dikembangkan berada pada kategori sangat layak dengan nilai rata-rata 83,7%. Uji keefektifan dilakukan dengan memberikan pre-test dan post-test kepada siswa kelas X SMK dengan analisis menggunakan rumus N-Gain. Hasil uji keefektifan menunjukkan bahwa nilai rata-rata siswa sebelum menggunakan multimedia adalah 51,33 dan setelah menggunakan multimedia adalah 78,67. Disimpulkan bahwa pembelajaran dengan menggunakan multimedia dapat meningkatkan hasil belajar siswa. Multimedia dapat memudahkan siswa dalam memahami materi pembelajaran.

A B S T R A C T

Learning conditions during this pandemic have limited direct teacher and student meetings. Online learning in SMK has several obstacles, such as the lack of appropriate learning media, which impacts student learning outcomes. This study aims to produce a simulation model of multimedia products in Basic Electrical and Electronics subjects in Vocational Schools. This type of research is development. This study uses the Bergman & Moore development model. The feasibility test was obtained based on expert studies conducted by material experts and media and learning design experts. The data collection technique used a formative evaluation instrument. This product development uses quantitative data analysis techniques and qualitative data analysis techniques. The instrument used to collect data is a questionnaire. The feasibility test results show that the multimedia with the simulation model developed is in the very feasible category with an average value of 83.7%. The effectiveness test was conducted by giving pre-test and post-test to class X SMK students with analysis using the N-Gain formula. The effectiveness test results showed that the average score of students before using multimedia was 51.33 and after using multimedia was 78.67. It was concluded that learning using multimedia could improve student learning outcomes. Multimedia can make it easier for students to understand learning materials.

1. INTRODUCTION

The Covid-19 pandemic has changed many things in a short period of time. Never before has there been in modern human history a pandemic that took place and spread as rapidly as this Covid-19. Society is forced to adapt to a very high level of uncertainty, both at the individual level, the smallest community, to the largest community (Ahmad & Triastuti, 2021; Shodiq & Zainiyati, 2020; Yulia, 2020). The world of education in Indonesia must immediately switch from Face-to-face Learning (PTM) to Distance Learning (PJJ) (Sari, 2020; Sukendro et al., 2020; Tamboto et al., 2021). Although it is not the most ideal choice, PJJ using ICT facilities is the best choice. So educators and students must immediately transform learning from conventional methods to digital/electronic learning (Ali, 2020; Djamdjuri et al., 2020; Hanik, 2020). Since March 2020, face-to-face learning activities in Indonesia must be replaced suddenly with Distance Learning, starting from the early childhood education level to higher education. In some areas in Indonesia students switch to learning digitally or electronically, but in some other areas not all students can participate in digital learning due to limited access and media. Some of the obstacles that arise in implementing PJJ, including the difficulty of teachers in managing PJJ and still focusing on completing the curriculum (Fikri et

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al., 2021; Hutauruk & Sidabutar, 2020; Rachmat & Krisnadi, 2020). In addition, not all parents are able to accompany their children in carrying out Learning from Home (BDR) because they have to work or lack the ability to accompany their children's learning.

Previous research stated that the implementation of learning from home in class X SMK 1 Dasa was quite effective with a percentage of 60-79% (Wiranata, 2021). It is recommended that in implementing BDR teachers are required to be able to design learning activities from planning to evaluation in a simpler, creative and effective way. Vocational High Schools (SMK) are designed to prepare graduates to work in certain fields (Ariyanti, 2020; Hidayat & Muladi, 2016; Utami, 2017). Vocational schools are required to be able to produce graduates as expected by schools, communities, and the business/industry world (Bustanil S et al., 2019; Disas, 2018). The manpower needed is manpower who has work competence in accordance with his field, has high adaptability and competitiveness (Maharani et al., 2018).

Therefore, the learning approach in SMK requires various improvements and reinforcements. Based on the results of preliminary research obtained in the field and based on previous research and the conditions of the learning process during this pandemic due to the limitations of meetings with teachers, according to the researchers, a learning media is needed that can be used by students as a substitute for the presence of teachers during the implementation of Learning from Home. Online learning in SMK has several different obstacles from online learning at other school levels. SMK has practical activities which are usually carried out in the laboratory. The implementation of this BDR is a challenge for teachers and vocational students who will carry out practical activities (Albab, 2019; Fikri et al., 2021).

In improving the optimal learning process, then in the implementation of digital learning communication is needed between students and teachers by utilizing information and communication technology such as computer media with the internet and mobile phones with various applications. (Islam Sarker et al., 2019; Jang et al., 2021; Muhtadi et al., 2018). The role of the teacher in facilitating students to fulfill their needs that have an impact on learning outcomes is very large. The development of learning media can be carried out by teachers as an actualization of their abilities, as stated in the Regulation of the Minister of National Education Number 16 of 2007 concerning Standards for Academic Qualifications and Teacher Competencies, it is explained that teachers must use information and communication technology for learning purposes. (Hibana & Surahman, 2021; Laksmi et al., 2019). Teachers also use information and communication technology to communicate and develop themselves (Suryani et al., 2018).

To meet the media needs, the researchers will develop a multimedia product simulation model in the Basic Electrical and Electronics subject. The development of the digital world in the world of education has a significant influence on the interaction patterns of teachers and students. Students who have excellent technological literacy tend to get bored faster when learning goes conventionally. The teacher-centered paradigm tends to be less effective when used to examine knowledge that requires student interaction, there is a need for teacher innovation in choosing the media used to attract students' attention. (Setiawan et al., 2021; Suryani, N., Setiawan, A., & Putria, 2018). Along with the development of technology and its supporting infrastructure, efforts to improve the quality of learning can be carried out through the use of this technology in a system known as digital learning. (Elyas, 2018; Handayani, 2021; Wahyudin et al., 2020). Digital learning is a system that can facilitate learners to learn more widely, more, and varied (Hibana & Surahman, 2021; Sukmanasa et al., 2017). The learning material that is learned is not only in verbal form, but is more varied such as text, visual, audio, and motion. Multimedia is one of the media that can be used in learning (Arywiantari et al., 2015; Buchori, 2019; Incedayı, 2018). Multimedia is a combination of information such as text, graphics, images, photos, animations, audio, and photos (Gluzman et al., 2018; Sugandi & Rasyid, 2019). Multimedia consists of a combination of various aspects such as text, video, and images. Audio and animation that can clearly show the learning objectives. Multimedia learning is often referred to as multimedia, which is used to help students understand the learning material in order to achieve certain learning goals. (Bardi & Jailani, 2015; Widyatmojo & Muhtadi, 2017). Multimedia has elements that can support the learning process, and the elements contained in multimedia such as text, graphics, images, video, animation, audio, and interactivity are very good for students and teachers to understand. (Audhiha et al., 2021; Primamukti & Farozin, 2018).

The findings of previous research stated that multimedia can improve students' understanding of learning (Hotimah & Muhtadi, 2018; Kuswanto & Walusfa, 2017). Other research findings also state that innovative multimedia attracts students' attention in learning (Anggraini & Sartono, 2019; Nugroho & Iqbal Arrosyad, 2020). Previous research stated that the interactive multimedia produced was practically used by teachers and students in the learning process by taking into account practicality, including ease of use, speed of time, product attractiveness, easy to interpret, and has the same equivalence (Arif & Mukhaiyar, 2020). The difference between this research and development with previous research and with existing learning media lies in the product being developed, namely multimedia with a simulation model for Basic Electrical and Electronic subjects that will be used by class X students during the implementation of distance

learning or Learning from Home. Basic Electrical and Electronics subjects in Vocational High Schools, testing the feasibility and effectiveness of multimedia with a simulation model developed for use in Basic Electrical and Electronics subjects. Through the development of multimedia with this simulation model, it is hoped that it can help class X SMK students in understanding transistor material in Basic Electrical and Electronics subjects.

2. METHODS

The research conducted is a type of research and development (R&D). The model used in multimedia development with a simulation model on transistor material in the Basic Electrical and Electronics subject is the Bergman & Moore model which consists of 6 stages of development, namely Analysis, Design, Development, Production, Incorporation, and Validation. The data collection technique in this development research was initially carried out by conducting interviews with school principals, vice principals, department coordinators and subject teachers. The instruments used in the initial research were interview guidelines and a questionnaire form filled out by students online. Data collection techniques at the development stage use formative evaluation instruments. This product development uses quantitative data analysis techniques and qualitative data analysis techniques. Quantitative data analysis techniques come from questionnaires which are then displayed through graphs or tables. The feasibility test data was obtained using a validation questionnaire from material experts, media experts and learning design experts. The quantitative data obtained were analyzed through several steps, among others, by calculating the average score of each item of the instrument and calculating the average total score of each component or aspect using the formula: Feasibility Score = answer score/maximum score x 100%. Then compare the average scores on each component based on the eligibility criteria as in Table 1.

Table 1. Table of Eligibility Scale Criteria

Achievement Level	Qualification	Information
90% - 100%	Very Worthy	No need to revise
75% - 89%	Worthy	No need to revise
65% - 74%	Decent enough	Revised
55% - 64%	Less worthy	Revised
0% - 54%	Not feasible	Revised

(Arikunto, 2006)

3. RESULT AND DISCUSSION

Results

In the development of this multimedia simulation model, the first stage carried out by the developer is analysis. This analysis is divided into four steps, namely problem analysis, target analysis, task analysis and environmental analysis. From this analysis, it was found that the Covid-19 pandemic resulted in all activities at SMKN 39 both delivering material and practice being done online. Other problems were revealed after interviews were conducted with the Principal, Deputy Principal, Coordinator of Departments and Teachers of Basic Electrical and Electronic Subjects. Based on a visit to SMKN 39 Jakarta which is in the red zone, the Principal of SMKN 39 explained that BDR has been carried out since March 2020. Teachers should be able to immediately prepare the distance learning process with their students. Materials and assignments started through the WhatsApp Group application which was very easy to do at that time. Practical activities for class XII were abolished and replaced with tutorials and assignments via video by the teacher and discussed with students online. Based on the results of interviews with the Principal and Deputy Principal of SMKN 39, developers were recommended to conduct research in class X Audio Video Engineering Department. Basic Electrical and Electronics. This is because class X students have to understand the basic components of electricity and electronics where students have not gotten the material in depth when they are at the junior high school level.

The next interview with the Basic Electrical and Electronics teacher showed that during this pandemic, the teacher provided material to students using modules that were distributed through the WhatsApp Group, in addition to videos sourced from YouTube, which were used to complete the material and online face-to-face discussions with students were also conducted through Google Meet. The obstacle faced during the learning process is in directing students to understand the material that requires direct practice. First, during this covid-19 pandemic, all students carry out the learning process from home using mobile phones, computers or laptops. Second, all students are able to find additional material through textbooks, modules, google, youtube, and brainly. Third, all students are actively involved in completing

assignments given by the teacher. Fourth, there are obstacles in the form of difficulty understanding some of the material presented by the teacher and too many assignments given by the teacher, besides the internet network and the availability of quotas are obstacles felt by students. The obstacles experienced by students during the implementation of Learning From Home include: students do not understand the material presented by the teacher through the module because it is not explained directly, the number of tasks given by the teacher, learning is less effective and unfocused, incomplete material and lack of explanation from the teacher, and internet quotas and unstable internet networks. Based on this description, it can be concluded that the character of class X students of SMKN 39 is that students are accustomed to learning in a disciplined and independent manner, students can access other relevant learning resources and students easily access communication channels and information technology media. Students are expected to be able to learn and think about the application of the material they learn in everyday life

The second stage in product development is design. At this stage, it produces a description of the products developed and groups them into general designs and detailed designs. The general design is in the form of a material framework and program structure, while the detailed design is in the form of providing material, presenting stimulus and providing questions for students. The Dick & Carrey model will be included in determining general & specific learning objectives, instructional strategies. Outline of Media Content (GBIM) and Outline of Material (JM) are the products produced in this design stage. In GBIM, the basic competencies are formulated to analyze the bias work of transistor circuits. Then the indicators are to explain the difference between NPN and PNP transistors, determine the requirements for biasing the transistor, classify the types of configurations on the transistor, and demonstrate the work of the transistor circuit bias. In JM, the learning materials that will be given to students are described. The third stage is product development. This development stage is carried out by preparing documents for the production stage, including the order of presentation of the material being developed into flowcharts and storyboards, the program structure being developed into a navigation design.

The fourth stage of this development is production. This production stage translates flowchart documents, storyboards, and other scripts into displays in a medium. Audio scripts are implemented through the selection of voice recordings or music as audio media. The material script is implemented through the creation of materials and practice questions to produce multimedia. The fifth stage is merging. This merging stage is the stage of integrating several media into one complete product. Audio, text and animation media that have been produced are combined into a complete series of presentations. Then the test is carried out to find out the errors as improvement material. Next is the adjustment to see the smoothness and improve the presentation and interaction into a multimedia product that is ready to be validated. The final stage of product development is validation. At this validation stage, it involves material experts, media experts and learning design experts as well as class X students majoring in Audio Video Engineering to find out the feasibility of multimedia with simulation models in Basic Electrical and Electronics subjects.

Based on the results of the validity given by the learning media experts, they get a percentage of 97.6% so that they get very good qualifications. The validation results from Learning Design experts are 97.6% so that they get very good qualifications. The validation results from the material experts are 76.7% so that they get good qualifications. The results of the One-to-one trial were 77.1% (feasible) and the results of the Small Group were 83.4% (Very feasible). The results of the feasibility test carried out by experts and users, it can be concluded that multimedia with this simulation model is very feasible to be used by class X Vocational High School students in Basic Electrical and Electronic subjects. Furthermore, to find out the results of the effectiveness test, it is carried out by giving pre-test and post-test questions to 15 students of class X SMKN 39 majoring in Audio Video Engineering. The following are the results of the pre-test and post-test of class X students. The results of the multimedia product effectiveness test with an N-gain of 0.59 or 59% are included in the moderately effective category. So it can be concluded that this simulation model multimedia product is quite effective to use in Basic Electrical and Electronics subjects. The results of the effectiveness test with N-gain are presented in Table 2.

Table 2. Effectiveness Test Results with N-gain

Average value		Big improvement	Number of students	The highest score		Lowest value	
Pre-test	Post-test			Pre-test	Post-test	Pre-test	Post-test
51,33	78,67	27,33	0,59	70	90	20	50

Discussion

Multimedia simulation model in the subject of Basic Electricity and Electronics that was developed is suitable for use by students. The feasibility of using a multimedia simulation model of this transistor material can be seen based on the results of questionnaires from experts and students. The implementation of digital learning by utilizing information and communication technology such as computer media is able to optimize learning (Islam Sarker et al., 2019; Jang et al., 2021; Muhtadi et al., 2018). The use of digital learning media can increase the teacher's role as a facilitator so that it has a huge impact on learning outcomes (Pinatih et al., 2021; Rohmanurmeta & Dewi, 2019). The development of learning media can be carried out by teachers as an actualization of their abilities for learning purposes (Hibana & Surahman, 2021; Laksmi et al., 2019). Teachers also use information and communication technology to communicate and develop themselves (Suryani et al., 2018). The teacher-centered paradigm will disappear because of teacher innovation in choosing the media used to attract students' attention (Setiawan et al., 2021; Suryani, N., Setiawan, A., & Putria, 2018). Along with the development of technology and its supporting infrastructure, improving the quality of learning can be done through the use of this technology in a system known as digital learning (Elyas, 2018; Handayani, 2021; Wahyudin et al., 2020).

Multimedia is one of the digital-based innovative media that can facilitate learning (Hibana & Surahman, 2021; Sukmanasa et al., 2017). The learning materials presented in multimedia are not only in verbal form, but are more varied such as text, visuals, audio, and motion. Multimedia is a combination of information such as text, graphics, images, photos, animations, audio, and photos. (Gluzman et al., 2018; Sugandi & Rasyid, 2019). This makes it easier for students to understand the material presented in multimedia (Arywiantari et al., 2015; Buchori, 2019; Incedayı, 2018). Audio and animation presented in multimedia can help students understand learning material quickly so that it will have an impact on increasing student knowledge (Bardi & Jailani, 2015; Widyatmojo & Muhtadi, 2017). Multimedia has elements that can support the learning process, and the elements contained in multimedia such as text, graphics, images, video, animation, audio, and interactivity are very easy and interesting for students and teachers to understand. (Audhiha et al., 2021; Primamukti & Farozin, 2018). The findings of previous studies also state that multimedia is feasible to use in learning (Ilmiani et al., 2020; Putri & Muhtadi, 2018). Other research findings also state that multimedia can improve student learning outcomes because it is very interesting (A. Syawaludin et al., 2019; Ahmad Syawaludin et al., 2019). It was concluded that this multimedia was very useful for students.

Multimedia with this simulation model can contribute to the development of learning media at SMKN 39, students can study independently at home. Multimedia with this simulation model can be one of the interesting learning media for students and teachers of other subjects can develop learning media like this even better. which cannot be implemented in schools. The developed multimedia has several limitations, including multimedia can only be accessed online, the simulation activities presented are still lacking, students still need assistance from teachers when using this multimedia, during trials with students there are several gadgets that cannot access multimedia, trials are not carried out directly face to face in class due to the Covid-19 pandemic, so until all research and development activities are carried out online.

4. CONCLUSION

The results of the validity given by the experts to the developed multimedia get very good qualifications. The results of the multimedia product effectiveness test are included in the moderately effective category. So it can be concluded that this simulation model multimedia product is quite effective to use in Basic Electrical and Electronics subjects. Multimedia simulation model can improve student learning outcomes.

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