

# Development of Educational Game Media Based on Android for Supporting Blended Learning in Basic Electronics Lessons

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## ABSTRACT

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The objectives of this study were to: (1) develop Android-based learning media for supporting blended learning in introductory electronics lessons and (2) determine the effectiveness and the student satisfaction level of the developed product.

This study used the Research and Development method with the ADDIE development model, which consisted of defining, designing, developing, implementing, and evaluating stages. The research subjects consisted of two media expert validators, two material expert validators, and 31 product trial students. The research instrument used a questionnaire for media and material experts, also tests and questionnaires for students. This study uses the percentage technique to determine the student satisfaction level of the developed product. At the same time, the product testing carries out with an experimental design (before-after) and a one-group pretest-posttest pattern.

This study has produced an educational game media based on Android to support blended learning in introductory electronics lessons. The results showed that the product developed obtained a validity score of 82.5% from media experts, which was on valid criteria. A score of 93.7% from material experts was in very valid criterion. The post-test average score of 80.97 is higher than the average pre-test score of 64.09. The level of student satisfaction with the product developed was excellent, with an average score of 85.8 on a scale of 100. The developed product can effectively support blended learning in introductory electronics lessons at vocational schools.

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## Introduction

The nature of learning carried out by students is more aimed at forming mental and character to continue life after graduating from school, through the forging given by the teacher

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through the teaching and learning process that uses appropriate learning methods and media to change the level of knowledge for students.

Vocational High School is a school that aims to create competent graduates according to their fields who are ready to enter the world of work. Students are also required to be able to adjust to following developments in Information Technology (IT) in the industrial world. The quality of learning needs to be improved to keep up with the increasingly advanced developments in the industrial world.

SMK Negeri 1 Wanareja is a school with the vision to create a vocational school with character, competence, and excellence. This fact shows that SMK is very serious about producing quality graduates. There are various educational programs at SMK Negeri 1 Wanareja, one of which is the Electrical Power Installation Engineering (EPIE) study program. This program seeks to create quality graduates ready to work in the electricity sector with a solid current concentration.

The preparation of students to become graduates of vocational schools who are ready to work needs to be supported by the excellent school management, professional teachers, adequate infrastructure, complete practice laboratories, and an effective learning process. The reality shows that many vocational high schools still need to meet these criteria. Especially for learning, adequate media support still needs to be improved for most schools. On the other hand, the world of education is facing a disruption caused by many factors, such as a disease pandemic and the rapid development of information technology. In situations like this, the school must prepare basic things such as adequate infrastructure and, good school governance, an adaptive and fun learning process for students.

As mentioned above, one way to deal with the challenges of disruption is to organize blended learning activities supported by media based on information technology. Empirically, it has been proven that blended learning can encourage students to have high motivation in learning, to like the multimedia used by the teacher, and to feel happy (Jusuf, 2016). Blended learning activities, namely a combination of face-to-face and online (Graham, 2006), are believed to be effective and flexible learning models, enabling teachers to maximize the many positive educational functions and appropriate the characteristics of contemporary students (Dziuban et al., 2018). On the other hand, studies conducted by Indonesian researchers provide an illustration that blended learning for electronics lessons provides quite good effectiveness, can improve learning outcomes, and gives students positive perceptions (Dewantara et al., 2020). Studies on the application of blended learning, which are more convergent, aiming at vocational high school students as subjects, have been carried out by researchers in recent years. Shinta & Candra (2021) found that the application of blended learning to learning electrical and electronics for vocational

school students significantly increased student learning outcomes. The research also states that another effect of applying blended learning is that students become more active and motivated in carrying out electrical and electronic learning, which is known to be challenging to understand.

According to the review above, blended learning needs to be considered as a choice a learning model for vocational school students. Learning success requires optimal support from all the components involved, one of which is the media. Teachers need to consider trends in students' daily habits in compiling media. As the latest generation, today's students have a contemporary lifestyle that is used to carrying out activities with the help of information technology. One of the media that should be considered for its use to support blended learning is Android-based educational game media.

Educational games have become increasingly popular in educational settings in recent years because of the advantage of providing opportunities for students to experience learning in a multi-sensory, active, and experimental environment (Cheung & Ng, 2021). Educational game media can also be a learning environment that can produce creative thinking (Bulut et al., 2022). According to these two views, using educational game media in a lesson can provide opportunities for students to actualize their creativity, using all of their senses through many experimental activities. Thus, blended learning can make students active and quickly acquire skills and knowledge. Educational games integrated with distance learning have also motivated, attracted attention, generated self-confidence, and increased student satisfaction in learning and are suitable for supporting digital design learning (Velaora et al., 2022). A comparative test conducted by Liu et al. (2020) concluded that students who participate in game-based learning and gamification show increased motivation and interest in learning. In addition, students also have a high assimilation power to the material being studied and show much higher learning outcomes compared to the learning control group without educational game media. For vocational school students, the use of educational games in digital electronics learning has significantly improved digital electronics and basic electronics learning outcomes (Kotsifakos et al., 2020).

In recent years, many Game-based learning platforms have been developed specifically to support learning for vocational school students. It is because, in the digital era, vocational education and technology need to meet the needs that support the professional work of teachers so that vocational education can become an adaptive and innovative institution. Vocational education teachers are more interested in practical matters about educational game media than in researching their effectiveness. That is what made North et al., (2021) create a game-based learning platform development project on a large scale. The project aims to create a digital game-based learning (GBL) platform that lets education professionals browse and share GBL content and resources quickly. This project also creates a community of GBL teachers who can shape GBL

activities and discuss and solve design-based and content-related problems in embedding GBL in their teaching practice. North's steps inspired this study in trying to provide a synergetic step by participating in developing GBL media for vocational school students in Indonesia.

**Method**

The method used in this study is research and development (R and D). According to (Sugiyono, 2015), R and D methods are used to produce specific products and test the effectiveness of these products. The research design model used was the ADDIE design model. The ADDIE model is one of the learning system design models that shows the basic stages of learning system design that is simple and easy to understand. ADDIE stands for analysis, design, development, implementation, and evaluation. The five stages are deemed appropriate for this research because they have been broken down systematically to deal with learning problems related to instructional media use.

This model becomes a guide in building systems and learning models that are practical, dynamic, and support the program's performance. The five stages are considered very suitable for developing this game media because they are simple and effective in doing so.

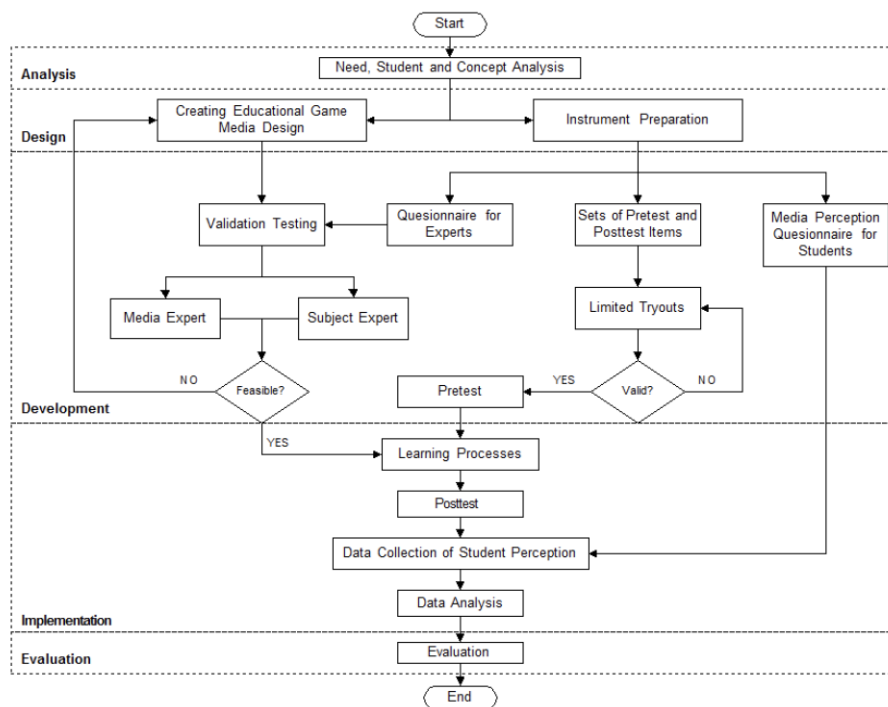


Figure 1. Research and Development Procedure

Product trial testing using the One Group Pretest-Posttest Design. This test is a product trial by providing a pretest before being given treatment; thus, the treatment results can be known to be more accurate because they can compare with the situation before being treated. This study used an experimental design (before-after) because this study compared the conditions before and

after using new teaching media. Meanwhile, to find out students' responses about multimedia products, it is done by filling out a multimedia questionnaire.

The subjects in this development were media and material expert validators, two people each. The subjects of the limited trial study were students of the electrical installation engineering study program at SMK N 1 Wanareja who took the Basic Electrical and Electronics subject, a total of 31 students. Data on student learning outcomes were obtained through two stages, first before using the educational game media (pre-test) and second after using the media (post-test).

## **Result and Discussion**

### **Analysis**

The analysis phase in this study begins with preliminary study activities. According to the direct observations in the electricity department of SMK N 1 Wanareja, obtained information that students still find it challenging to understand the primary material of Electrical Electricity. The media used in the basic learning process of electronic electricity is still simple and monotonous, and the school still needs to integrate with the development of IT. The needs analysis results show that in the teaching and learning process activities, in terms of the media used by the teacher, it looks simple. Some media is displayed separately, not in the form of a single file, making it less attractive and ineffective. Through this analysis, researchers are motivated to develop media to make it more attractive and effective and can increase student enthusiasm to improve learning outcomes.

This study found the problem to be solved through direct field observation activities, including students still needing help learning electrical and electronics lessons. The others problem is a learning support media still does not arouse students' interest and motivation because they need to be more varied and use information technology. On the other hand, some previous study explores the importance of research from a literature review. Yulianti & Ekohariadi (2020) found almost the same problem as this research through a literature study. Even so, the two studies provided almost the same results in problem identification.

### **Design**

This design aims to create media that will be developed according to a predetermined concept regarding appearance and interactivity. There are several stages in preparing a media design, including preparing the media templates; preparing the text, images, animation, audio, and video needed in developing the media; and creating designs that will be made in the primary electrical electronics educational game media.

### **Development**

Development is the process of making designs into reality and validating the products being developed. One of the stages of development is preparing content. The development of this

educational game media product will go through validity testing by media experts and material experts to obtain media feasibility. The media that is being developed will be tested and assessed by these experts and then forwarded to the product revision stage until it is declared that the product is feasible and ready for use.

**Validation of test instruments**

Instrument validity was needed to determine how valid the questions used for data collection in the research were. Valid questions will be used in research, while invalid questions will be removed. The questions used in the trial were 35 multiple-choice questions.

**Instrument reliability**

The results of calculating the reliability of test items obtained  $r_{11} = 0.93$ ; because the value of  $r_{11}$  obtained is between  $0.90 < r \leq 1.00$ , the item is declared reliable with a very high category.

**Media Feasibility**

The subjects who became media experts were productive teachers from two schools. Media Expert 1 is a teacher in the Department of Software Engineering at Majenang Pharmacy Vocational School, and Media Expert 2 is from the Building Department at SMK N Wanareja. The following is the result of the eligibility data for media experts:

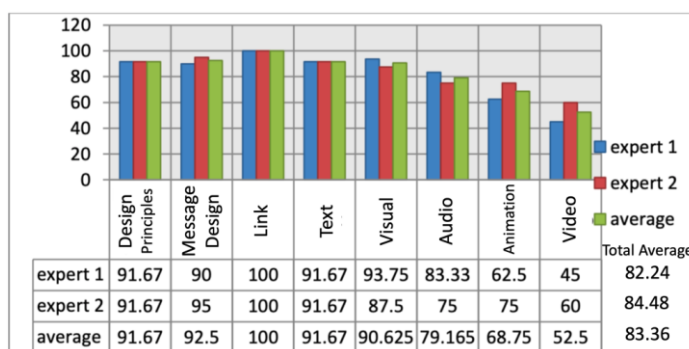


Figure 2. Graph of media expert validation results

The graph in Figure 2 shows the assessment of media expert 1, with a proportion of 82.24%. Refers to predetermined criteria; this value is in the valid criteria. Assessment by media experts 2 with a proportion of 84.48% is in the valid criteria too. From the assessment of the two media experts, the average value of 83.36% is in the valid criteria, so this study can state that educational games for primary electrical are suitable for learning media. The graph also shows that the two experts assessed the video aspect (52.5%) and animation (68.75%) in low validity value. This result indicates that the media design in both aspects still needs to be improved. Related to these results, the two experts have provided suggestions for improvement as material for product design revisions. Some suggestions and input from media experts include using short and light audio.

### Material Feasibility

Expert subjects in the data analysis of material feasibility are productive teachers at the department of Electrical Power Installation Engineering SMK N 1 Wanareja as Material Experts 1 and productive teachers of Electrical Power Installation Engineering at Muhammadiyah Majenang Vocational School as Material Experts 2. Following are the results of material expert feasibility on educational game media that has been developed.

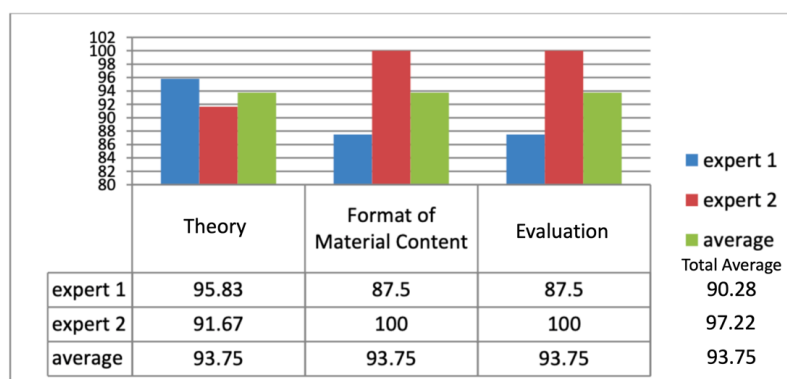


Figure 3. Graph of material expert validation results

Referring to Figure 2, expert-1 and expert-2, respectively, provide an average validity score of 90.28% and 97.22%. This score shows that the material in the developed media meets the requirements for learning. Experts view that the aspects of theory, the format of subject matter, and evaluation in developed media have been well prepared. So, this study concludes that from a material perspective, the media developed in this study is valid and appropriate to be used as a medium for learning basic electricity and electronics for vocational high school students.

Even though they give an excellent score in the material aspect of the developed product, the experts still provide suggestions for media improvement. These suggestions include, among other things, developers can add resistor materials and how calculating them. The developer then uses this input to improve the designed media product.

### Implementation

Implementation is a concrete step to realize and apply the developed media products. This stage can also be called the field trial stage by implementing educational game media as developed products, applied as learning media in the classroom. To determine the increase in learning outcomes among students who use learning media before and after development, use a test instrument as a pretest-posttest. The test was carried out with an experimental design (before-after) with the group pretest-posttest test. The class in the study was not chosen randomly, but rather that all subjects in the group were determined. The data analysis was instrument validation, media feasibility, and gain test. After receiving the test, students fill out a

questionnaire regarding using the developed educational game media to explore their perceptions as users.

### Effectiveness Test

The developed educational game media is effective, as seen from the increase in the pretest-posttest results, namely tests before and after using the developed education game media in the basic electrical and electronics learning process. Based on the pre-test results, this study finds out a minimum value of 53.3 and a maximum value of 76.7, and the average pre-test value was 64.09. In comparison, the post-test results obtained a minimum value of 70.00 and a maximum value of 90.00, with an average value of 80.97. The results of the pretest-posttest mean score can be seen that there is an increase in the value of 16.88.

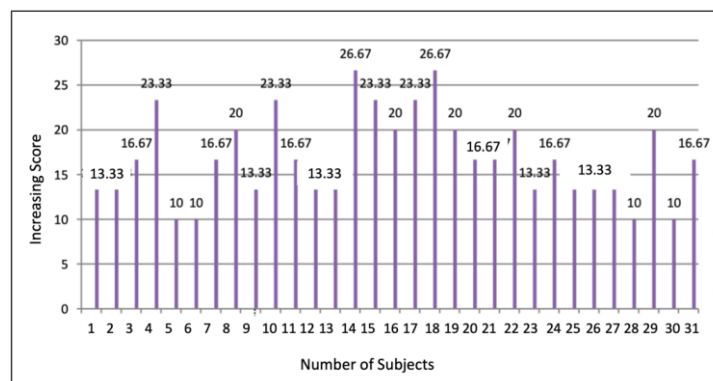


Figure 4. Graph analysis of the effectiveness test (pretest-posttest)

According to Figure 4, this study can show that all subjects experienced an increase in learning outcomes, so blended learning using the developed educational game media has a positive learning effect. From these results, blended learning using the developed product can increase the effectiveness of learning basic electrical and electronics for vocational high school students. The results of the posttest scores were higher because students felt treated after taking the pretest. The pretest is a stage to determine students' initial abilities in understanding primary electrical and electronic material to obtain appropriate treatment in the teaching and learning process. So, the game educational media built through this research combined with blended learning can improve the effectiveness of vocational students in electrical and electronic learning.

The results of this comparison are similar to the outcomes of previous research. Shinta & Candra (2021), through their study, found that the average learning outcomes of electrical and electronic lessons for vocational school students who use blended learning had a higher score (83.42) than the scores of students in the control group (74.5). Meanwhile, the results of research by Satrio et al. (2021) found that game-based learning through E-CrowdWar effectively improved students' academic outcomes, despite differences in average scores. The results of previous research have confirmed the results of this study that educational game learning media combined with blended learning has a positive learning effect.



### The normalized gain test

This research uses the normalized gain test to determine how students' mastery of material increases before and after learning. From the pretest-posttest results obtained, the research then calculated the gain value of each student. Figure 5 represents the gain value that calculates before.

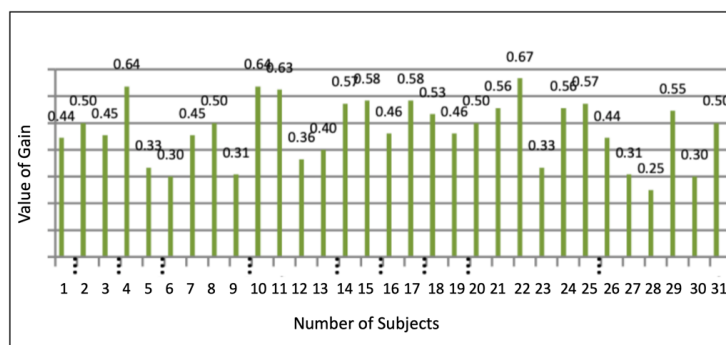


Figure 5. Graph of gain test analysis

According to these gain values, mapping is carried out based on predetermined criteria. Based on these steps, this study found that all subjects experienced an increase in the moderate category. That means increasing learning outcomes in the class obtains "moderate" criteria. This study also found an average difference value of 0.47 and included it in the high criteria.

### Student perception level

This research uses a questionnaire to determine student perception levels. As the trial subject, students will assess the use of educational game media in the learning process. They will choose every questionnaire item relevant to their opinion of the developed products. The following are the results of students' perceptions of the developed educational game media in the learning process.

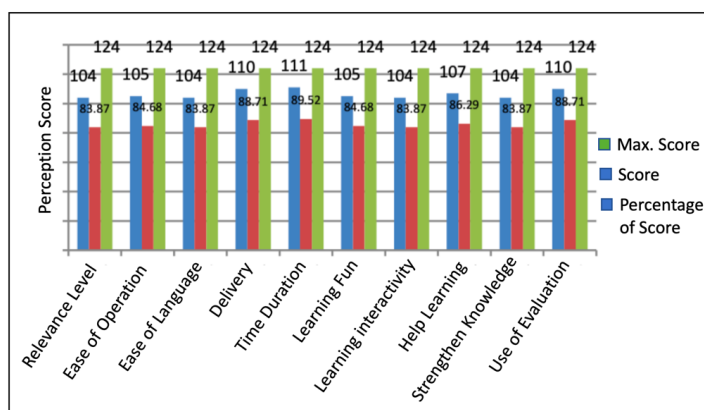


Figure 6. Graph of students' level of perception

According to Figure 6, can be calculated the average level of student perception. This study found that the average student perception of the developed product was 85.8 percent. It shows that the subject gives an excellent perception of the developed media. This study has proven that students perceive the media used as relevant to learning material. Students feel that the media uses an easy-to-use language that is easy to understand and can convey material well. From the graph, students feel that the time spent using the media is appropriate; learning is to be fun and interactive and can help to learn achievement. This study also found that students perceive that the developed media can strengthen the knowledge acquired and provide useful evaluation tools as feedback for further learning.

This study provides the same results as previous studies regarding ease of operation, interactivity, and user experience. Through a review of six research results regarding learning media using educational games, Yulianti & Ekohariadi (2020) found that educational game applications made have the advantages of being easy to use, interactive, and an Android-based user experience. Meanwhile, Velaora et al. (2022), through their research, found that students felt quite interested (66.7%), less motivated (33.3%), and significantly helped (83.3%) by the educational game media used in learning. For the motivation parameter, these results indicate a different situation from the subject of this study. This finding can be an exciting study in future research.

### **Evaluation**

Evaluation is a process carried out to provide value to the quality of processes and refined products before and after implementation. So at this stage, it is an evaluation of the results of field trials using educational game media products, including primary electrical and electronic material. This evaluation activity is in the form of a final revision of the product after field trials to make a final product that is categorized as suitable for use in classroom learning.

### **Product Revision**

Media and material experts carry out the assessment. Apart from assessing, the experts also provided suggestions for improvements to the developed product. The experts on the questionnaire sheet wrote suggestions about the developed product. This study uses these suggestions as a reference in revising the product. The following is a description of the developed product revision in this study.

Suggestion-1: In the Electrical Resistance section's menu, the developer needs to add the resistor material and tool to calculate the resistor's value. Response-1: the developer has added content and a tool to calculate the resistor value. Suggestion 2: use short audio and make it easy to listen. Response-2: there is already audio that is simple and easy to hear. Figure 7 shows the screen display of the media before and after revision for menus related to resistance materials.

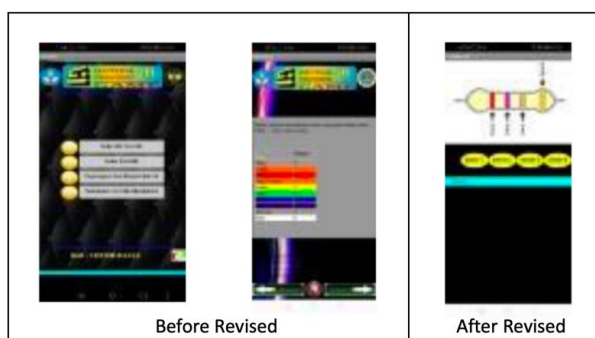


Figure 7. Product revision for improving electrical section menu

Experts also provide suggestions related to the evaluation tools. Suggestion-3: in evaluating student questions, add notification of student scores. Response-3: there is already a notification to display the evaluation result value. Figure 8 shows the screen display of the media before and after revision for menus related to evaluation screen.

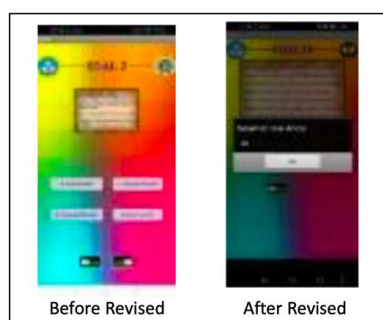


Figure 8. Product revision for improving evaluation menu

## Conclusion

Based on data analysis and discussion of research results, this study can conclude that the android-based educational game media built through this research can be appropriately used to support blended learning, which consists of face-to-face and online activities, in electrical and electronic engineering lessons for vocational high school students. The resulting product has a good learning effect; namely, it can increase the effectiveness of learning electrical and electronic techniques for SMK students. The research also found that vocational students gave excellent perceptions of the product developed as an Android-based educational game media.

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