



Designing and Developing Android-based E-Book as a Guide for Students in Making Smart-Key: A Learning Media for Electronic Circuits Course

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Abstract: Learning media can be incredibly valuable in the study of electronic circuits, as it is an abstract concept that demands meticulous attention to detail. This study aims to determine the feasibility value and student response to the android-based smart key e-book as a learning media. This study is a research and development which followed ADDIE (Analyze, Design, Develop, Implement, and Evaluate) model and involved physics education students as research subjects. The e-book was validated in two stages, the first was an expert judgment involving 3 media experts, and the second was a feasibility test on students. The results of this study indicate that the e-book is declared very feasible, because all three experts gave a score above 80, and based on the results of the product feasibility trial, students presented an average score of 85. This study provides findings in the form of an Android-based e-book as a guide for making smart keys that are proven suitable for use in learning electronic circuits. Furthermore, this article discusses in detail the development and benefits of the product, along with the limitations of the research to be taken into consideration for further research.

Keywords: Android; E-book; Smart-key.

Introduction

Technological developments have formed new study habits for most students (Hsueh, Zhou, Chen, & Yan, 2021; Meina, Fan, Kaining, & Yang, 2021; Murcia, Pepper, Joubert, Cross, & Wilson, 2020; Romanenko, Puyu, Romanenko, & Fedorin, 2022; Antomi Saregar et al., 2020). It is undeniable that the level of knowledge and technological literacy are two of several indicators of successful achievement of good quality education (Dagienė, Hromkovič, & Lacher, 2021; Rigelman, Vennebush, & Saxton, 2021; Vinogradova, Borisova, & Kornienko, 2022). Therefore, as one of the facilitators in learning, teachers and lecturers should have the ability to utilize technology in learning, such as using it as a

learning media. (Fan & Ye, 2022; Leow & Neo, 2014; Lu, Wu, & Huang, 2022; Luo, 2022; Vinogradova et al., 2022).

Education is held to improve the quality of personal and social life, in which there is human interaction that lasts a lifetime (Kasirer & Shnitzer-Meirovich, 2021; Kim, 2020; Pietrapertosa et al., 2021). The success of students is also determined by educators (teachers and lecturers), especially because the learning process begins with them (Fernández-Cézar, Solano-Pinto, & Garrido, 2021; Jin, Su, & Chen, 2021; Mykhnyuk & Suleymanov, 2021). In the electronics circuit course, there are theoretical and practical learning activities. These learning activities require learning media such as videos, books, and ebooks, which contain practical guidelines, one of which is in the practice of making smart keys with a biometric system.

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The use of learning media is very effective for increasing the activity of students in the process of teaching and learning activities and making it easier for educators to convey learning messages and information (Amalia, Fadilah, & Anwar, 2020; Andriani, Dewi, & Sagala, 2019; Ceh & Lebuda, 2022; Farhan, Nurlaili, Susanna, Soewarno, & Yusriza, 2021; A. Saregar et al., 2019; Utami et al., 2021). Learning activities of students with the help of media will be able to produce better learning outcomes. Moreover, the use of digital media allows students to study independently anywhere and anytime, they can learn at school, at home, even while playing (Ahmad et al., 2021; Bittner, Mirbabaie, & Morana, 2021; Dewi, Pahriah, & Purmadi, 2021; Marshalsey & Sclater, 2020; Marshel, Ratnawulan, & Fauzi, 2021; Tawil & Dahlan, 2021). Android for Linux-based smartphones Android provides an open platform for developers to be able to create their own applications that can be used by a variety of driving devices. This advantage can be utilized by educators to develop instructional media to assist the delivery of electronic circuit learning, thereby making teaching and learning activities interesting (Ahmad et al., 2021; Hsia, Lin, & Hwang, 2021; Petrova & Vasichkina, 2022; Presicce, Jain, Rodeghiero, Gabaree, & Rusk, 2020; Wongchiranuwat, Samat, Kanjug, & Wattanachai, 2021).

As a tool, the media has a function to arouse or foster students' interest in actively participating in learning (Culpepper & Gauntlett, 2020; Novitra, Festiyed, & Yohandri, 2021; Schlauch, 2022; Selfa-Sastre, Pifarré, Cujba, Cutillas, & Falguera, 2022; Timotheou & Ioannou, 2021). And one of the advantages of digital media is that it can overcome the limitations of space and time (Dashkina, Dmitrijev, Khalyapina, & Kobicheva, 2022; Kholis & Munoto, 2020; Sathanarugsawait, Samat, & Wattanachai, 2021). Apart from that, digital learning media displays lots of pictures and videos that can motivate students to be more diligent in learning (Ruiz-Mallén, Heras, & Berrens, 2021; WilliamCheng, JosephNg, Eaw, & Phan, 2022; Yousef, 2021).

Research related to the development of digital learning media has been found, including in Syahrowardi's research which developed multimedia-based handouts that illustrate how to make multimedia-based handouts using professional 3D pageflips with a final display that can be accessed via computers and smartphones (Syahrowardi & Permana, 2016). Other research that developed a mobile learning multimedia module based on the Android operating system provides novelty in the form of an introduction to biodiversity for high school students (Suryanda, Ernawati, & Maulana, 2018). There is also research on the development of Android-based chemistry learning media which presents the results of the feasibility of learning media and the results of its evaluation of the

academic performance of high school students (Yektyastuti & Ikhsan, 2016). Development of digital media on guidelines for designing smart doors using fingerprints (Yudhana, Sunardi, & Priyatno, 2018). However, so far no research has been found related to the development of an Android-based e-book which contains a guide for making smart keys as a learning media for implementing electronic circuits. This research was developed in order to achieve the goal of knowing the feasibility of this e-book and to find out student responses to this e-book as a learning media.

Method

The development applied in this study followed the ADDIE development model which has five stages of development, analysis, design, development, implementation, and evaluation (Jonnalagadda, Singh, Gogineni, Reddy, & Reddy, 2022; Lubis, Andayani, & Habibullah, 2020; Spatioti, Kazanidis, & Pange, 2022). The stages of the ADDIE model in this study are described in detail as follows.

Analysis was carried out in two stages, work analysis and needs analysis. At the work analysis stage, this analysis is carried out to find out and classify the problems faced by students related to learning media at the university, so that later solutions are made to improve or develop better quality learning support media, according to student needs. Furthermore, the needs analysis stage is carried out to determine the learning media needed by students to improve the quality of learning, as well as student motivation and achievement.



The design stage includes activities to design instructional media, in this stage a focus group discussion is held to discuss the content according to the needs analysis. The results of this stage are in the form of an e-book design framework. Furthermore, the media is made based on the design framework of this stage.

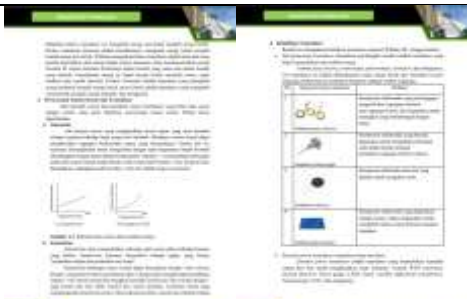
Furthermore, in the Development stage, the e-book is developed based on the design from the previous stage. The development stages in this study include 1) Creating a smart key tool that was previously designed at the design stage, 2) Writing the contents of the e-book using several applications, including Microsoft Office 2016, 3) Designing the cover and drawing additional images needed in the e-book -book with the CorelDraw 2020 application, 4) Finalize the completed e-book design into a 3D digital page-flip application, 5) Conduct product validation tests, 6) Improve learning media according to suggestions and input from the material and design expert team. Furthermore, a detailed description of the contents of the final e-book is shown in Table 1.

After the product is declared valid by the expert, the product entered the Implementation stage, namely the application of the e-book in online learning to find out student responses regarding this e-book. By conducting trials in small groups or large groups, student response data is obtained in the form of a questionnaire.

Next is the Evaluation stage which consists of formative evaluation and summative evaluation. Where in the formative evaluation, the researcher evaluates each stage that has been carried out, reviews the data from each stage. Meanwhile, the summative evaluation is carried out by analyzing the results of student responses related to the e-book.

Table 1. Android-based e-book contents

No	Content	Description
1	Cover 	The cover includes: 1) An overview of the topics, discussions, and practices that students will get in this e-book. 2) The names of the authors of this e-book, so that if there are things that are not understood by students in this book, students know where to ask.
2	Opening 	The opening section includes: Preface, Introduction, and Table of Contents. In this section students can find out the purpose of e-book development and details of the contents of the e-book.
3	Instruction 	This section contains pages that show how to use the e-book and the tools used in practice, made in detail and clear by displaying pictures, so that students can understand how to use the e-book more easily
4	Core Part 	This section contains: 1) Mind Maps Created to help students understand the concepts to be discussed/ concepts to be applied in practice.



2) Theory
Written with mature thought and summarized from various sources so that students get basic concepts related to practice.

3) Practice Guide
Prepared in detail with pictures and practical steps so that students can work independently without assistance from a lecturer.

5 References



Contains reading references used in the preparation of the e-book. Well written according to the standards of the American Psychological Association 7th edition so that it can make it easier for students to find the sources directly.

In collecting research data, the research instruments used were pre-research questionnaires, validation questionnaires, and student response questionnaires. The data collected is in the form of qualitative and quantitative data, qualitative data is in the form of statements of student needs and suggestions from validators, while quantitative data is in the form of assessment scores on guide ebook research sheets on the subject of android-based sensors and transducers in tertiary institutions filled by content experts and media experts

Result and Discussion

This research produced a product in the form of an Android-based ebook, a guide for making smart keys with the aim of knowing the response of validators and students to the ebook. This e-book is also made as a

learning medium in electronics circuit courses, especially on the topic of sensors and transducers.

Content Expert Review

There were 2 theoretical physicists (electronic physics) involved in the content assessment. The validation carried out by material experts is related to aspects of the relevance of the theory. The content expert team provides suggestions for improving the e-book and provides an assessment of the revision results. After revision, content experts provide an assessment of this e-book. The results of content expert validation are shown in Figure 2.

Figure 2 shows that the average of each aspect in the content validation results reaches 81.75%, meaning that the e-book meets the criteria of being very feasible for use in learning.

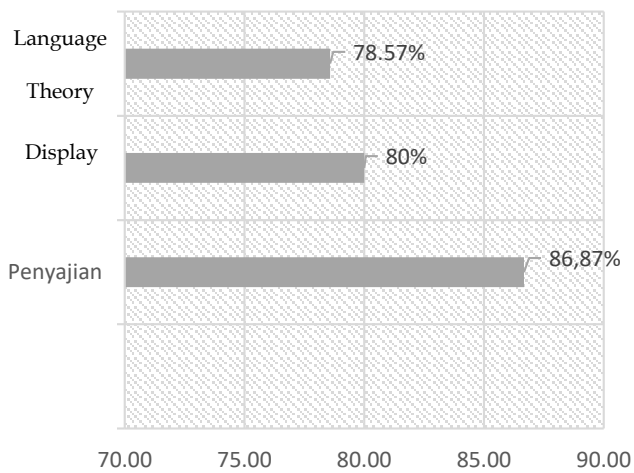


Figure 2. Conten Validation Results

Media Expert Review

In media validation, three learning media experts were involved. The media expert team reviews and gives a value to the media display. The results of the feasibility assessment from the media expert team can be seen in Figure 3.

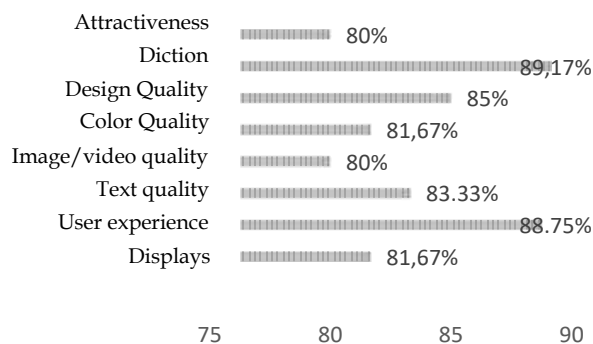


Figure 3. Media Validation Results

From Figure 3, it can be seen that the average of each aspect in the media validation results before the revision reached 83.7% with very decent criteria.

Small-scale Trial

The small product trial phase was carried out online with 29 student respondents from three universities in Lampung province, Indonesia, UIN Raden Intan Lampung, University of Lampung, and UMM (Muhammadiyah Metro University). All of the 29 students gave a good response in this trial. There are 3 aspects that are measured through student responses, an overview of student responses to these three aspects is shown in Figure 4. From Figure 4 it can be seen that the average of each aspect of the response results from students shows an average of 88.69%, meaning that,

based on the assessment of 29 respondents, this e-book is very interesting and suitable for use in learning.

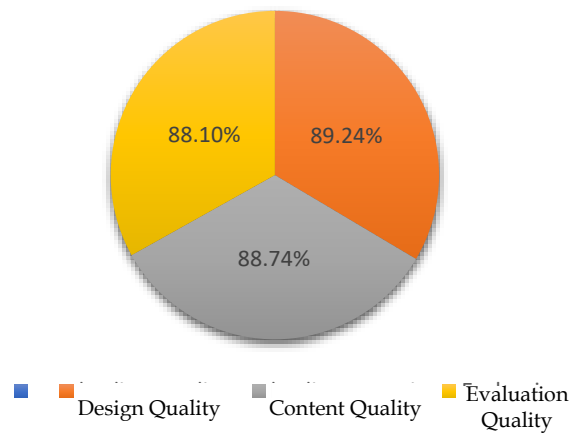


Figure 4. Students responses in small-scale trial

Large-scale Trial

In the large-scale product trial stage, 78 physics education students in Lampung were involved. The assessment criteria used are still the same as small-scale trials, design quality, content quality, and evaluation quality. The results are shown in Figure 5.

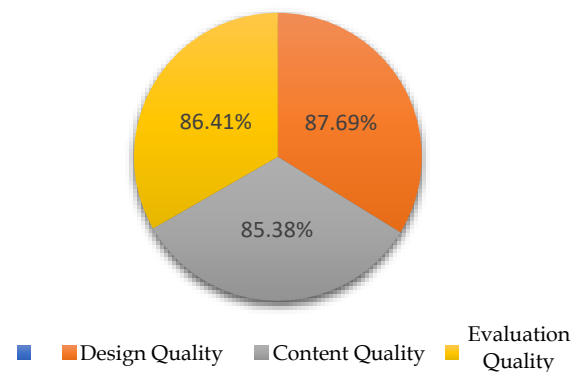


Figure 5. Students responses in large-scale trial

Figure 5 shows that the average of each aspect of the student response results is 86% with very interesting criteria. This research succeeded in developing an ebook for making Android-based smart keys on sensor and transducer materials in universities. The development process uses a series of stages of the ADDIE model developed by Robert Maribe Branch, which consists of analysis, design, development, implementation, and evaluation.

Analysis is carried out as an initial reference for conducting research on students, educators, learning media or curriculum used by tertiary institutions. Based on the results of the pre-research, student interest is still lacking in electronics courses, especially sensor and transducer materials, this is due to the limited learning media used in the process of teaching and learning activities. So this is also the background for researchers

to develop learning media, the learning media developed on this occasion is in the form of an Android-based ebook which contains a guide for making smart keys. This is intended to change the habits of students who are less active in learning. Based on previous research, learning media is proven to increase students' interest in studying electronics (Ahmad et al., 2021; Aswardi, Nellitawati, & Arda, 2019). The topics raised in this e-book are sensor and transducer materials.

At the design stage, the researcher developed an e-book media with contents in the form of theory and practicum steps, there were three main discussions including sensors and transducers, smart keys, and guidelines for making smart keys. The addition of theory written in the e-book aims to make students better understand the basic concepts used for practice.

At the development stage, as explained in the method section, the realization of the design stage is carried out. At this stage the researcher also conducted a validation test from experts. Furthermore, at the implementation stage, learning media is tested on students either on a small or limited scale or on a large scale.

The average result of student responses in small-scale product trials reached 85.74% with a very interesting category. So that overall the learning media in the form of an e-book guide for making Android-based smart keys developed by researchers can be grouped into very good categories. Besides that, educators and students also provide suggestions or responses including the following media that are developed to help students understand sensor and transducer material, provide new knowledge to students. As for the input in the form of suggestions for learning media there is no improvement, so that it can be continued to the next stage, namely large-scale product trials.

In the large-scale product trial stage, as many as 78 students from the three universities in Lampung were involved. The average percentage of student responses reached 72.543%, meaning that students found this product attractive and ready to use. Overall this e-book learning media is ready to be disseminated.

This research contributes to education in the form of Android-based e-book learning media to help students understand how to make smart keys, as well as practice how to make them. This media is quite unique because previously there has never been an e-book development with a similar topic. Although there are many research related to the development of digital learning media has been found, including in Syahrowardi's research which developed multimedia-based handouts that illustrate how to make multimedia-based handouts using professional 3D pageflips with a final display that can be accessed via computers and

smartphones (Syahrowardi & Permana, 2016). Other research that developed a mobile learning multimedia module based on the Android operating system provides novelty in the form of an introduction to biodiversity for high school students (Suryanda, Ernawati, & Maulana, 2018). There is also research on the development of Android-based chemistry learning media which presents the results of the feasibility of learning media and the results of its evaluation of the academic performance of high school students (Yektyastuti & Ikhsan, 2016). Development of digital media on guidelines for designing smart doors using fingerprints (Yudhana, Sunardi, & Priyatno, 2018). However, so far no research has been found related to the development of an Android-based e-book which contains a guide for making smart keys as a learning media for implementing electronic circuits. This research was developed in order to achieve the goal of knowing the feasibility of this e-book and to find out student responses to this e-book as a learning media.

Despite the strength of this research, however, this research still has limitations, such as the sample used is limited to students in one province in Indonesia, it would be better for further research to be able to test the feasibility of an e-book guide for making Android-based smart keys to students with a sample from various provinces in Indonesia to avoid research bias

Conclusion

Based on the results of research and development of an android-based e-book as a guide for making smart keys on the application of electronic circuits in Lampung universities, it can be concluded that: The average feasibility result of the content expert team reached 81.75% with very decent criteria, and the average eligibility result from the media expert team reached 85.73% with very feasible criteria. The response from students also showed very good results, reaching 86.50% in the very interesting category. In this study, the sample used was limited to students in one province in Indonesia, it would be better for further research in order to be able to test the feasibility of the e-book for making Android-based smart keys to students with samples from various provinces in Indonesia to avoid research bias.

Author Contributions

Conceptualization, Yuberti Yuberti; E-Book design, Happy Komikesari; Analysis and writing, Nur Endah Susilowati.

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Conflicts of Interest

The authors declare no conflict of interest

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