



The Development of Android-Based Interactive E-Modules in Technical Drawing Subjects

Ovel Geta Nafeli^{1*}, Rijal Abdullah¹, Ambiyar¹, Asrul Huda¹

¹Faculty of Engineering, Padang State University, Padang, Indonesia.

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Corresponding Author:

Ovel Geta Nafeli

ovel.geta.nf@gmail.com

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Abstract: The aim of this research is to produce valid Android-based e-module, practical and effective in the subject of Engineering Drawing. Android-based e-modules are designed to increase student understanding thereby improving student learning outcomes. The data analysis technique used descriptive analysis techniques to describe the validity, practicality, and effectiveness of Android-based e-modules. Results obtained from this development research that the validity of the Android-based e-module is declared valid in the media aspect and material aspect. The practicality of the Android-based e-module from teacher and student responses was stated to be very practical. The effectiveness of Android-based e-modules is stated to be effective in improving learning outcomes. Based on the findings of this research, it was concluded that the Android-based e-module was declared valid with an average value of 0.88. Practicality, it was declared very practical based on teacher responses with an average score of 96.0% and student responses with a score of 87.8%. The effectiveness with classical completeness of 90.91% was declared effective to be used as a learning aid in the Technical Drawing subject.

Keywords: Android; E-Module; Technical drawing

Introduction

Information technology becomes an interactive medium used for long-distance communication to exchange information (Famy & Tukino, 2022; Warint et al., 2020). Technological developments are developing quickly, and are reaching all areas of education, even faster than expected (Attori et al., 2021; Kifli et al., 2021). Technology is rapidly and revolutionary changing human thinking and civilization. It is important to utilize technology with a positive attitude, policy and responsibility, especially in formal and informal learning contexts (Prawiradilaga, 2016).

If the educational process occurs in a school environment, the aim is to ensure that changes in students occur in accordance with planning, including increases in knowledge, skills and attitudes in accordance with the objectives of the educational

program being implemented (González-Yebra et al., 2020; Hiroi & Ito, 2023). Curriculum requirements are increasingly complex, and the required facilities and infrastructure are also becoming more complex. Involvement in the learning process is increasingly diverse and more intense (Na et al., 2022; Ogunkola & Knight, 2018). It is no longer limited to communication between teachers and students, as well as between fellow students, but also includes interactions between students and learning materials directly (Egiazarian et al., 2020; Sharifi, 2020). This can happen through various learning media and additional learning sources, one of which is technical drawing. It is a way to express ideas and concepts related to systems, processes, construction, schemes, arrangements, as well as directions that provide instructions or data that can be represented in the form of technical drawings or illustrations (Schlagenhauf et al., 2023; Vergara et al., 2021).

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Currently, almost every student has a smartphone because it is very necessary to search for information via the internet, to contact friends, or to be active on social media (Borba & Ferreira, 2022; Mukminin et al., 2019). The positive effects of smartphones are for communicating with friends and family, searching for information in various parts of the world, getting more information, as a calculating tool to replace a calculator, taking pictures or photos and for entertainment such as listening to music, watching movies and playing games and adding friends because there is social media to interact with other people from various parts of the world (Contreras et al., 2018; Ogunkola & Knight, 2019).

Besides the positive impact, smartphones also have a negative impact on students, including: disrupting focus when studying because they are constantly that rely on smartphones, inhibiting direct interaction with friends and family because of the ease of long distance communication, increasing spending on credit or quotas, which can burden finances, as well as reducing motivation for physical activity, such as doing sports (Manimaran et al., 2022; Megahati et al., 2022; Muzaffar et al., 2022; Painter & Kadhiwala, 2018).

The negative impact of smartphones above is also a factor in disrupting learning activities in the classroom. Based on information from teachers, students are often caught stealing the opportunity to use their Android smartphones when the teacher explains the learning material, causing students not paying attention to the material being presented and not understanding what the teacher is explaining. Android-based learning media has the potential to create learning resources for students. Thus, the smartphone devices owned by students are not only used for social media activities, but also function as learning support tools. This has a positive impact, that students become more proactive and are able to overcome boredom that may arise in the learning process, which previously was only limited to the use of whiteboards, PowerPoint presentations, and lecture approaches.

Android-based learning media opens up opportunities for students to be more interested in learning (Hidayat et al., 2023; Isrokatun et al., 2023). By downloading and installing various educational applications through the Play Store, students have the opportunity to obtain more interesting learning materials (Elida et al., 2023; Siahaan et al., 2021). Play Store itself is an application platform that is usually installed on Android devices. By using the Play Store, students can download various applications they need, not only limited to social media, such as Facebook, Instagram and WhatsApp, but also various learning media applications. Therefore, the researcher intends to conduct study entitled "Development of an Android-Based Interactive E-Module in the Class X Technical

Drawing Subject at SMKN 1 SUMBAR", with the aim of optimizing the use of Android technology in the Engineering Drawing learning process.

Method

Research and development (R&D) methods are used in the research approach in this study (Sugiyono, 2020). The design of an Android-based interactive e-module for the Engineering Drawing subject adopts a 4-D (Four-D) development model approach. Research sample of class X DPIB SUMBAR students regarding the e-module that has been developed. Distribution was carried out after ensuring that the e-module has passed validation, been proven practical and efficient by validators and has undergone the testing phase. The effectiveness of the e-module was assessed by observing student learning outcomes and comparing them with the pretest and posttest results. Android-based e-module product trials were carried out using the One-group pretest posttest approach.

The main data used in this Android-based e-module development research was obtained directly from various sources. This main data included the validation results of Android-based learning modules, which had been evaluated by validators, responses from teachers and students expressed through media practicality questionnaires, as well as effectiveness test results obtained from student learning assessments, using relevant statistical analysis.

Results and Discussion

The e-module that is being developed has the characteristics of containing text, images, and videos to support students' understanding of the material. Based on input from validators, adjustments are made so that the resulting e-module meets validity standards and becomes an appropriate learning resource for Engineering Drawing subjects.

Stage Development

After completing the design stage, the next step is the development stage. This stage aims to create e-modules that are valid, practical, and effective. This stage included evaluating validity and reliability through assessments from validators, practicality assessments by lecturers, teachers and students in using e-modules, as well as testing the effectiveness of e-modules through evaluating student performance on learning materials. The following is the e-module development process in detail.

Media Expert Validation

Before being implemented in the learning process, the e-module has passed a validation stage to ensure its suitability for use. Media validation refers to the evaluation of the resulting product design. This process involves two validators who are experts in the media field, with assessments focused on four main aspects: appearance, media programming, use and language.

Media validation is only performed once. The evaluation of each aspect provided by the validator was analyzed using the Aiken's V statistical method. The results of this analysis reflect the level of validity of the product design that has been produced. The findings from the validation process are in line with the results of the questionnaire used to evaluate the e-module that has been developed, which can be found in Table 1.

Table 1. Media expert validation results

Validator	Evaluation				Average
	Appearance Aspects	Programming Aspects	Utilization Aspect	Language Aspect	
Validator 1	0.87	0.91	0.95	0.81	0.88
Validator 2	0.90	1.00	0.80	0.87	0.89
Overall Average					0.88
Category					Valid

Based on analysis of validity test results by media experts, it is found that the Android-based learning e-module had a validation value of 0.88, which exceeds the threshold of 0.61. Therefore, the e-module can be categorized as valid.

Practicality Test Data

Response Teachers on the Practicality of E-Modules

The ease of use of the e-module developed is related to its practicality. Information regarding this practicality was obtained from the results of assessments via questionnaires filled out by Technical Drawing teachers. Based on the responses recorded in the questionnaire, the results regarding the ease of use of Android-based learning e-modules can be found in Table 3.

Material Expert Validation

The purpose of this validation is to evaluate whether the learning material in e-modules that use the Android platform meets learning needs. Aspects evaluated by material experts include material content, language use, and learning methods used. The validation process involves reviewing the content of the material in the e-module, followed by providing an assessment of the content presented in the Android-based e-module. The assessment of each aspect given by the validator was analyzed using the Aiken's V statistical method. The results of this analysis reflect the level of validity of the product design produced. The results of the validation, according to the results of the questionnaire used to assess the e-module being developed, can be found in Table 2.

Table 3. Teacher responses to the practicality of e-modules

Assessment	Later Aspects	Time Aspects	User Aspects
Practicality Score (%)	96	96	97
Overall Average (%)			96
Category			Very Practical

Based on the analysis, the average practicality test results of Android-based e-modules for the Technical Drawing subject according to the subject teacher concerned are with practical interpretation.

Table 2. Material expert validation results

Validator	Evaluation			Average
	Material Aspects	Language Aspect	Learning Aspects	
Validator 1	0.87	0.75	0.92	0.84
Validator 2	0.95	0.95	0.78	0.89
Overall Average				0.86
Category				Valid

Responses to the Practicality of E-Modules

The level of practicality of Android-based e-modules was also evaluated based on student responses. This information was obtained after students used the e-module in learning the Technical Drawing subject, followed by filling in a questionnaire by the student. Evaluation of the level of practicality of Android-based learning e-modules based on student responses can be seen in Table 4.

From the evaluation carried out by material experts, it is found that the validation value obtained was 0.86, exceeding the predetermined threshold value of 0.61, indicating that the material contained in the e-module could be categorized as valid.

Table 4. Student responses to the practicality of e-modules

Assessment (32 students)	Convenience aspects	Time aspect	Aspect of use
Practicality Score %	87.9	87.8	87.9
Overall Average (%)	87.8		
Category	Very Practical		

The average student response to the level of practicality of using e-modules in the Engineering Drawing subject reached 87,8%, with classification as very practical. From the results listed in Tables 4 and 5, the average results of evaluating the practicality of the Android- based Engineering Drawing e-module are 96.0% based on data from teachers and 87.8% based on data from students. Thus, it can be concluded that the e-module is very practical for use in learning Technical Drawing subjects.

Effectiveness Test Data

Analysis of the effectiveness of learning e-modules using the Android platform was carried out to evaluate the extent to which the e-modules succeeded in increasing student learning achievement. The following are the results of the analysis regarding the increase in student learning outcomes obtained from using the e-module.

Analysis of the Difficulty Level of Questions

The level of difficulty of a question is the level of difficulty or degree of difficulty of the items in a question answered by students, which is expressed as p (proportion). Based on the data collected, there are 36 questions in the category that have a medium level of difficulty, while there are 4 questions that are included in the easier category.

The level of difficulty of this question is determined by the quality of each question item. Its analysis based on this criterion involves evaluating the level of ability expected in each question item. Arikunto (2015) states that quality questions are the questions that are neither too simple nor too complicated. Questions that are too simple may not provide enough challenge for students, thereby not encouraging them to try harder in answering them.

Classical Completeness

Before implementing the e-module, research subjects underwent an initial test (pretest) to assess their level of knowledge before the learning process began. After using the e-module, a final test (posttest) was carried out to evaluate students' understanding after the learning process. Achievement of classical completion was measured based on the percentage of students who

achieve or exceed the minimum standard grade/KKM score after using e-modules using the Android platform. The Technical Drawing e-module is considered effective if the student's classical completion level reaches 85% or more. On the other hand, if the percentage of students who achieve classical completion is less than 85%, then the use of E-modules is considered ineffective. Details of the average student scores in the Technical Drawing subject can be shown in Table 5.

E-modules are considered effective if the level of student completion in one class is equal to or exceeds 85%. Based on the analysis results presented in Table 5, the average student completion level is 90.591%. This indicates that the classical completeness standards have been met, which implies that the use of Android-based e-modules has proven to be effective in accordance with the established classical completeness standards.

Table 5. Students' classical completeness

Activity	Amount Student	Max Score	Min Score	Passed KKM	% ($\geq 85\%$)	Remark
Pre-test	33	83	18	7	21.21%	Not Passed
Post-test	33	97	50	28	90.91%	Passed

Effectiveness Based on Gain Score Value

Gain score is a parameter that measures the increase in student learning outcomes from before (pretest) to after (posttest) an intervention or learning method. In the context of one group pretest posttest research, the effectiveness of Android-based e-modules is assessed based on the N-gain value. This value is calculated by measuring the difference between the pretest and posttest scores, and is used to evaluate how effective the method or intervention used is. The results of the N-gain test can be seen in Table 6.

Table 6. Gain score values

Gain minimal score	Gain maximal score	Average score	Category
33	0.18	0.91	0.736

From the analysis of student learning outcomes data, the average gain score reached 0.736, in the high category. Based on the cognitive learning results of students who use e-modules as part of learning, it can be stated that the e-modules prepared by researchers have proven successful in improving student learning achievement.

Disseminate Stage

After the e-module has passed the stages of validation, practicality testing, and satisfactory effectiveness measurements, it can be concluded that the

e-module deserves to be distributed more widely. The prepared e-modules can be introduced to other classes that teach similar subjects. Distribution was carried out by providing e-modules to teachers of Technical Drawing subjects to be implemented in class. This step is intended to ensure that teachers and students can use the learning media effectively, so that e-modules can become an effective tool in improving the quality of learning. The e-module design process continues until the deployment stage on the Google Play Store.

Discussion

Validity of E-Module

In the process of testing the validity of this e-module, its validity was obtained based on responses from four validators consisting of two media validators and two material validators. Data from validators was obtained by filling out a validity questionnaire given to them, which included an assessment of the Android-based e-module. After validation of the e-module by a media validator, a media score of 0.88 was obtained, which indicates a valid category. Then, validation results by material experts also produced a score of 0.86, which is also in the valid category. Based on the validator's assessment of the media and material aspects, it can be concluded that the developed e-module is suitable for testing as teaching material in the Engineering Drawing subject. This finding is in line with previous research (Nissa et al., 2021), which states that digital-based e-modules have an average score of 0.91 and are included in the valid category and are suitable for use in distance learning contexts.

Practicality of E-Modules

Android-based e-modules was taken through trials carried out in class X DPIB SMK Negeri 1 SUMBAR. The assessment of the practicality of the e-module was obtained from teacher responses with a practicality value in terms of the convenience aspect of 96%, the time aspect of 96%, the usage aspect of 97%, and the average results obtained were 96% in the very practical category. Meanwhile, the practicality value based on student respondents in terms of the convenience aspect is 87.9%, the time aspect of 87.8%, the usage aspect of 87.9%, and the average results obtained are 87.8%, so it can be concluded that the e-module is based on Android as a whole is very practical to use. In accordance with research by Aryani & Wahyuni (2021) that learning e-modules must have very practical value so that they can be used as alternative teaching materials in learning.

E-Module Effectiveness

Testing the effectiveness of the Android-based e-module was carried out by observing the level of classical completion and gain score. The criteria for

evaluating the effectiveness of using e-modules is to examine the proportion of students who succeed in achieving the expected level of achievement after using the e-module. The percentage of student achievement is measured through tests before and after using the e-module. From the gain score analysis, it was found that the increase in value reached 0.736, indicating a high success category. Thus, it can be concluded that the Android-based e-module for Engineering Drawing lessons is considered successful in increasing student learning achievement.

This research is in line with the findings of Accraf et al. (2019), which states that the Android-based interactive e-module developed for the subject of chemical bonds and intermolecular forces is considered feasible and valid. This assessment involves validators, product design experts, material experts, practitioners, as well as limited trials, with the assessment criteria showing a very high level of feasibility. The feasibility percentage value from material experts is 91%, product design expert validators 89%, practitioners (subject teachers) 95%, and limited trials 85%.

Research carried out by Sidiq & Najuah (2020) focused on developing e-modules using the Android platform for the Teaching and Learning Strategy subject. This developed product successfully passed the validation stage by material experts with an agreement level reaching 93%, which can be classified as very high validity. Validation was also carried out by learning design experts with an agreement percentage of 82%, which was categorized as valid, and by media experts with an agreement percentage of 86%, also categorized as valid. Besides, 86% of respondents also stated that the use of this media was effective. The implication of these findings is that the e-module has the potential to inspire, motivate, and strengthen students' interest in learning independently, as well as increasing the effectiveness and efficiency of the learning process. This impact is ultimately expected to improve the overall quality of learning.

Afridiani (2022) research on Android-based e-modules as interactive learning media show that the product validity test results based on material and media validation were declared valid with a score of 0.81. Furthermore, the practicality test for lecturers showed a score of 86.44, which was categorized as very practical, while for students a score of 86.63 was obtained, also categorized as very practical. Furthermore, the results of the effectiveness test were obtained from the analysis of posttest scores, where the classical completion level reached 96.55%, which means it meets or exceeds the *KKM* limit of 70. From these results, it can be concluded that the Android-based learning e-module is effective in the context of Food Control learning.

The results of this research, together with related studies conducted by other researchers, consistently confirm that the use of e-modules can increase student learning achievement. Although there are differences in the research objects and subjects studied, overall, both this research and other relevant research, show the success of the development and implementation of e-modules. By utilizing e-modules in the learning process, students can better understand the material and learning becomes more effective.

Conclusion

This research produces an interactive e-module for the Engineering Drawing subject, which is designed based on Android. The content includes text, images, and videos. This e-module is designed to be used online, allowing students to access it anytime and anywhere via smartphone by downloading the application from the Google Play Store. The development process follows the 4D development model. The resulting Android-based interactive e-module has been proven to have validity, practicality, and effectiveness. The validity of this e-module was assessed based on responses from media experts and material experts, both of which received valid assessments. The practicality of the e-module was assessed through responses from subject teachers, which were considered very practical, as well as responses from students, which were also considered very practical. The effectiveness of the e-module is assessed based on student learning outcomes, which are proven to be effective. The results of data analysis on Android-based e-modules as interactive learning media from product validity tests based on material validation with a value of 0.86 and media with a value of 0.81 which were declared valid. The practicality test on teachers resulted in a score of 96%, which was rated as very practical, while on students it resulted in a score of 87.8%, which was also rated as very practical. Furthermore, the effectiveness test was carried out by analyzing the results of the posttest scores, where the classical completeness level reached 90.91%, which is considered to have achieved completeness with a KKM limit of 75. This indicates that the Android-based interactive e-module is effective in supporting the learning of Technical Drawing.

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Conceptualization, data curation, funding acquisition, methodology, visualization, writing - original draft, and writing-review & editing: O.G.N., R.A., A., and A.H.

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Conflicts of Interest

We certify that there is no conflict of interest with any financial, personal and other relationships with other peoples or organization related to the material discussed in the manuscript.

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