



Level of Difficulty in Developing Android-Based Learning Media

Susanti Setiyani^{1*}, Febri Liantoni², Puspanda Hatta³ 

^{1,2,3} Pendidikan Teknik Informatika dan Komputer, Universitas Sebelas Maret, Surakarta, Indonesia

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ABSTRAK

Salah satu kompetensi guru adalah merancang dan memproduksi media pembelajaran, terdapat berbagai jenis media pembelajaran salah satunya berbasis android. Terdapat keterkaitan yang kompleks antara teknologi dan teori yang mendorong pada domain pengembangan mencakup fungsi-fungsi desain, produksi dan penyampaian. Tujuan dari penelitian ini adalah untuk menganalisis tingkat kesulitan pengembangan media pembelajaran berbasis Android. Subjek penelitian ini adalah 30 mahasiswa PTIK yang pernah mengembangkan media pembelajaran android hingga pengujian pengguna. Pengumpulan data dilakukan dengan instrumen penelitian berupa angket. Data yang diperoleh selanjutnya dianalisis menggunakan statistik deskriptif dan kemudian dikategorikan menjadi 3 tingkatan kesulitan pengembangan yaitu tinggi, sedang dan rendah. Adapun hasil analisis menunjukkan tingkat kesulitan mahasiswa berada pada kategori sedang dengan presentase 77%, dimana tingkat kesulitan tertinggi ada pada aspek develop dengan presentase kesulitan kategori tinggi sebesar 13%, pada aspek desain sebesar 10%, aspek analisis 7%, aspek implementasi 7%, sedangkan pada aspek evaluasi tidak terdapat mahasiswa dengan kesulitan dengan kategori tinggi. Simpulan penelitian yaitu kesulitan pengembangan ada pada aktivitas didalam software pengembangan seperti proses pengunggahan asset kemudian terkait pemahaman struktur pemrograman serta kemampuan penyediaan kebutuhan pengembangan seperti perangkat uji coba dan kesesuaian spesifikasi perangkat.

ABSTRACT

One of the teacher's competencies is designing and producing learning media; there are various types of learning media, one of which is Android-based. A complex relationship between technology and theory drives the development domain, including design, production, and delivery functions. This research aims to analyze the difficulty level in developing Android-based learning media. The subjects of this research were 30 PTIK students who had developed Android learning media and user testing. Data collection was carried out using research instruments in the form of questionnaires. The data obtained was analyzed using descriptive statistics and then categorized into three development difficulty levels: high, medium, and low. The results of the analysis show that the student's level of difficulty is in the medium category with a percentage of 77%, where the highest level of difficulty is in the developing aspect with a high category percentage of difficulty of 13%, in the design aspect it is 10%, the analysis aspect is 7%, the implementation aspect is 7%. Meanwhile, in the evaluation aspect, there were no students with difficulties in the high category. The research concludes that development difficulties lie in activities in development software, such as the asset upload process, and are then related to understanding the programming structure and the ability to provide development needs, such as test equipment and suitability of device specifications.

1. INTRODUCTION

Science, technology, and information development are progressing rapidly in all fields. Many aspects have utilized digital in every activity, especially in developing learning media, including the education sector. Development is translating a design specification into physical form, writing, and creating learning materials (Munirah, 2018; Ramli AR, 2019; Tsalisah & Syamsudin, 2022). The development

*Corresponding author.

E-mail addresses: susantisetiyani@gmail.com (Susanti Setiyani)

consists of learning hardware and includes software, visual materials, audio, and programs, a combination of various parts (Natsir, 2017). One type of learning media development is Android-based. Android is software that is used on mobile devices as an operating system and core application, where the function of the Android operating system is as a bridge between devices and their use in various applications so that users can interact with their devices and run various applications desired (Aghajani & Adloo, 2018; Hakky et al., 2018; Yunus & Fransisca, 2020). Mobile learning applications are a variation of learning that utilizes handheld and mobile information and communication technology to learn and access learning materials anytime and anywhere (Arifuddin & Bahri, 2019; Sinaga et al., 2019). It is a form of utilization of interactive multimedia technology that can present learning content in the form of text, video, animation, and other multimedia (Warsita, 2018; Wulandari et al., 2019). Android-based mobile learning media use in basic computer and networking subjects has proven effective (Alyabri, 2021). Android learning media has proven effective (Abiyoga & Rahmiati, 2021).

In developing ICT-based learning media, three important components must be fulfilled to keep up with developments: infrastructure, human resources, content, or applications. Several realities occur in the field, such as human resources, where senior teachers tend not to master computers and do not want to learn to improve their ability to use computers, teachers who do not want to update their learning styles and tend to feel comfortable with old teaching styles (Adisel & Pranansa, 2020; Suripah, 2017). The use of interactive learning media is still relatively low, and conventional methods are still used (Salshabella et al., 2022; Telaumbanua et al., 2021). There is still a lack of teachers who utilize interactive learning media such as Adobe Flash as an alternative to delivering learning material; this is due to the low ability of teachers to use learning media tools (Yuwono et al., 2021). Due to a lack of teacher ability to develop learning media, students as prospective teachers need to prepare themselves to develop interactive learning media, and lecturers need to analyze the difficulties that arise for students in developing interactive learning media (Yuwono et al., 2021).

One effort to overcome this problem is to prepare prospective teachers. One effort to increase the quality of human resources requires a quality education system, so improving the quality of education through preparing prospective teachers must be done more (Muliyani, Rahmati, 2020). Difficulty developing learning tools but still need to be detailed regarding types and difficulties (Hamonangan & Sudarma, 2017; Malawi et al., 2017). Analyzing existing difficulties can guide developers to develop better learning media (Nasution & Nisa, 2018). The Informatics and Computer Engineering Education Study Program, FKIP Universitas Sebelas Maret, is one of the study programs that produces prospective teacher graduates and is a leading study program in the use of technology. PTIK FKIP UNS students are in an educational environment that studies learning technology, one of which is learning media development. Observation results from 38 students who had developed learning media, 30 of whom developed Android-based learning media. This research aims to analyze the difficulty level in developing Android-based learning media. The analysis of the level of development difficulty in this research will focus on five learning media development activities: analyzing, designing, developing aspects, implementing, and evaluating.

2. METHOD

This research uses a quantitative approach using survey methods with numerical or numerical data analysis. Data was sourced from questionnaires. Where the contents of the questionnaire are arranged based on a grid and involve one expert judge to validate the questionnaire. All data that has been collected is then analyzed using descriptive statistical techniques. The research procedure followed in this study consisted of 4 stages: planning, data collection, analysis, and conclusions. The planning stage begins with identifying the problem and then formulating the problem, objectives, and research methods that will be used. The next step is to determine the research instrument, consult with the supervisor, and validate and finalize the instrument at the data collection stage by distributing questionnaires to respondents. After the data is collected, it is processed and analyzed using descriptive statistical analysis techniques with the help of SPSS. The final stage is drawing conclusions and reporting. The population in this study were all PTIK FKIP UNS students who had previously developed Android-based learning media. After determining the research sample, determine the sample members to represent the research. The sampling technique uses a purpose sampling technique. The purpose of the sampling technique is to use a research sampling technique with certain considerations so that the data obtained can be more representative (Sugiyono, 2013).

Data collection in this research used a questionnaire. In this research, the statement questionnaire has a closed nature. Respondents will choose answers according to their conditions where the measurement scale uses Likert. The steps in creating a research instrument are divided into several stages, starting with identifying the variables that are the research problem, describing the variables into sub-sections, determining the indicators for each sub-section, then describing the grid and formulating

statement items and completing the instrument guidelines. This research uses one variable: the difficulty of developing Android learning media. The preparation of the instrument grid refers to 5 development activities, which are activities consisting of five categories: analyzing learning needs and conditions that occur, designing a set of effective and efficient learning environments, developing aspects that suit students and managing materials, implementing materials. which is developed in learning media, evaluating formative and summative results of development (Syamsudin, 2021). The five categories of development activities are adapted to Android-based learning media development activities, which are modified into instruments as in Table 1.

Table 1. Research Instrument Grid for Levels of Difficulty in Developing Android-Based Learning Media

Aspect	Indicator
Analysis	1. Functional Requirements
	2. Non-Functional Requirements
	3. Competence
Design	1. Making Flowcharts
	2. Interface/storyboard design
	3. Preparation of material, simulation, and evaluation
	4. Creating background, layout, and navigation buttons
	5. Asset Creation
Develop	1. Creation of projects and scenes
	2. Uploading assets
	3. Script preparation
	4. Making Android learning media into APK
	5. Final view
Implementation	1. Test black box testing
	2. Test the application on a smartphone
Evaluation	1. Evaluation Tool

(Noviana Khoirunnisa et al., 2018; Puspitaningrum et al., 2019)

The data obtained in the research was then analyzed using descriptive statistical techniques with the help of SPSS. Descriptive statistics used to describe data on the difficulty level of developing Android learning media are average (mean), standard deviation, and minimum and maximum values.

3. RESULT AND DISCUSSION

Results

The data analyzed in this research is the difficulty of developing Android-based learning media from the results of questionnaires filled in by respondents. The results of this research include a description of the data where this research was conducted in the Informatics and Computer Engineering Education study program, FKIP UNS. The respondents were 30 students with descriptive statistical results from providing 28 statements regarding the difficulty level of developing Android learning media. Can be seen in Table 2.

Table 2. Descriptive Statistics on the Difficulty of Developing Android-Based Learning Media

Descriptive statistics	Score
N	30
Minimum	58
Maximum	105
Mean	84.93
Std. Deviation	9.702

Based on Table 2, the results of descriptive statistics show that the lowest value is 58 and the highest value is 105, with an average score of 84.93.

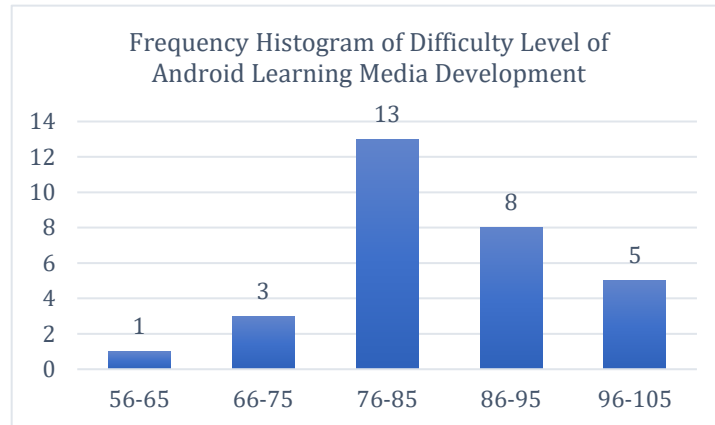


Figure 1. Frequency Histogram of Development Difficulty Levels

Based on Figure 1, the difficulty level in developing Android learning media consists of 5 intervals with a value range 10. Scores 76 to 85 have the highest frequency,13, and scores 56 to 64 have the least frequency, 1.

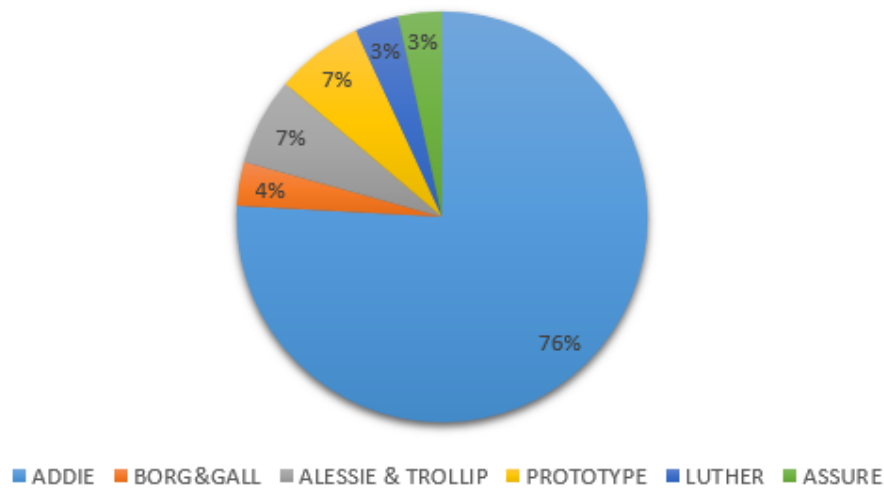


Figure 2. Pie Chart of the Development Model Used in the Sample

Of the 30 respondents who had developed Android-based learning media, there were six development models used, of which 22 students used the ADDIE 22 model, one student used the Borg & Gall model, two students used the Alessie & Trollip model, two students used Prototype, one student used the Luther model and one student used the ASSURE model.

Table 3. Categories of Difficulty Levels for Developing Android Learning Media

No	Category	Interval	Frequency	%
1	High	$X < 75$	2	7%
2	Medium	$75 \leq X < 95$	23	77%
3	Low	$X \geq 95$	5	17%
Total			30	100%

Table 3 shows that the level of difficulty in developing learning media for PTIK students can be categorized as high if the score obtained by students from the questionnaire results is less than 75 and included in the low category if the score is more than equal to 95. There are five stages in developing learning media: analysis, design, development, implementation, and evaluation. The results of the difficulty level categories based on each aspect of the development stages are presented in Table 4.

Table 4. Difficulty Level Categories in the Development Analysis Aspect

No	Category	Interval	F	%
1	High	$X < 13$	2	7%
2	Medium	$13 \leq X < 18$	22	73%
3	Low	$X \geq 18$	6	20%
Total			30	100%

Based on the grouping results, it can be seen that of the 30 students, there were two students with a high difficulty level in the analysis stage. In comparison, 22 students showed the medium category, and six students showed the low category. This analysis aspect has three indicators: functional needs analysis, non-functional needs analysis, and competency analysis. The results of indicator analysis at the development analysis stage are presented in Table 5.

Table 5. Results Of Indicator Analysis at the Development Analysis Stage

Indicator	Category		
	Low	Medium	High
a. Functional Requirements	30%	60%	10%
b. Non-Functional Requirements	30%	60%	10%
c. Competence	17%	83%	0%

Based on Table 5, the data shows that most indicators at the analysis stage received medium scores. Difficulty level categories in the development design aspect are presented in Table 6.

Table 6. Difficulty Level Categories in the Development Design Aspect

No	Category	Interval	Frequency	%
1	High	$X < 30$	3	10%
2	Medium	$30 \leq X < 39$	23	77%
3	Low	$X \geq 39$	4	13%
Total			30	100%

Based on categorizing the difficulty level in the design aspect, students with a score below 30 had a high difficulty level. In contrast, as many as three students experienced high difficulty at the design stage, and four students had low difficulty with a score of more than 39. Category of difficulty level for developing Android learning media The design aspect indicators are presented in Table 7.

Table 7. Difficulty Level Categories for Developing Android Learning Media Based on Design Aspect Indicators.

No	Indicator	Category		
		Low	Medium	High
1	Making Flowcharts	53%	37%	10%
2	Interface/storyboard design	30%	57%	13%
3	Preparation of material, simulation, and evaluation	17%	73%	10%
4	Creating backgrounds, layouts, and navigation buttons	23%	63%	13%
5	Asset Creation	33%	57%	10%

As seen from Table 7, for the indicators for making flowcharts, the majority of students have a low level of difficulty, while the indicators for designing interfaces, preparing materials, making backgrounds, and making assets have a medium level of difficulty for the majority. The categorization of the difficulty level in developing Android learning media in the development aspect is presented in Table 8.

Table 8. Categorizes the Level of Difficulty of Developing Android Learning Media in the Development Aspect

No	Category	Interval	Frequency	%
1	High	$X < 23$	4	13%
2	Medium	$24 \leq X < 31$	20	67%
3	Low	$X \geq 31$	6	20%
Total			30	100%

Judging from the results of the categorization of the development aspect, students with a score of less than 23 are included in the high level of difficulty category, where there are four students with a high level of difficulty in developing Android learning media in the development aspect and six students with a low level of difficulty who scored more of 31. Analysis of categories of difficulty level of Android learning media development on development aspect indicators is presented in Table 9.

Table 9. Analysis of Categories of Difficulty Level of Android Learning Media Development on Development Aspect Indicators

No	Indicator	Category		
		Low	Medium	High
1	Creation of projects and scenes	20%	67%	13%
2	Asset upload	17%	80%	3%
3	Script preparation	17%	77%	7%
4	Making Android learning media into APK	37%	60%	3%
5	Final view	30%	60%	10%

The categorization results in Table 9 show that most of the difficulty levels of the development aspect indicators are medium. In the low-level category, the indicator for making learning media into an Android application gets a presentation of 37%. At the medium level, the indicator for uploading assets gets a presentation of 80%. Furthermore, at the high level of categorization, the project and scene creation indicators obtained a presentation of 13% and 7% for the script preparation indicators. Categories of difficulty in developing learning media for implementation aspects are presented in Table 10.

Table 10. Difficulty Level Categories for Developing Learning Media for Implementation Aspects

No	Category	Interval	Frequency	%
1	High	$X < 5$	2	7%
2	Medium	$5 \leq X < 7$	23	77%
3	Low	$X \geq 7$	5	17%
Total			30	100%

From Table 10, there are two students in the high category with a score of less than 5 and 5 students with a low level of difficulty with a score of more than 7. Analysis of the difficulty level of Android learning media development in the implementation aspect indicators is presented in Table 11.

Table 11. A Category Analysis of the Difficulty Level of Android Learning Media Development on Implementation Aspect Indicators

No	Indicator	Low	Medium	High
1	Black box testing	20%	80%	0%
2	Test the application on a smartphone	17%	83%	0%

In Table 11, there are two indicators in the implementation aspect: the black box testing indicators and application testing on smartphones. Of these two indicators, the majority obtained a low difficulty level, presenting 80% for black box testing indicators and 83% for smartphone application testing, and no student obtained a high level of difficulty in each indicator. The difficulty level categories for developing Android learning media for evaluation aspects are presented in Table 12 and Table 13.

Table 12. Difficulty Level Categories for Developing Android Learning Media in Evaluation Aspects

No	Category	Interval	Frequency	%
1	High	$X < 2$	0	0%
2	Medium	$2 \leq X < 3$	10	33%
3	Low	$X \geq 3$	20	67%
Total			30	100%

Table 13. Difficulty Level Categories for Android Learning Media Development In Evaluation Aspect Indicators

Indicator	Low	Medium	High
Evaluation Device	67%	33%	0%

In the evaluation aspect, one indicator is the preparation of evaluation tools. In this indicator, most students obtained a low level of difficulty at 67% and a medium level of 33%, while in this evaluation aspect, there were no students with a high level of difficulty. The results of this analysis can be described based on each aspect in Table 14.

Table 14. Difficulty Level Categories for Developing Android-Based Learning Media for Each Aspect

Aspect	Percentage		
	Low	Medium	High
a. Analysis	20%	73%	7%
b. Design	13%	77%	10%
c. Develop	20%	67%	13%
d. Implementation	17%	77%	7%
e. Evaluation	67%	33%	0%

The overall research results show that of the 30 students studied, five students had low levels of development difficulty (17%), 23 had moderate difficulty (77%), and two students had high learning media development difficulty (7%). Based on this percentage, the difficulty of developing Android learning media for PTIK students is in the medium category

Discussion

From the results of the research data, the category of difficulty level for each aspect is that the majority of difficulties for each aspect are in the medium category, with the evaluation aspect being in the low category. All samples used modeling in developing learning media, with the ADDIE development model being the most widely used by 22 students. In addition to ensuring the quality of learning content, modeling helps developers determine development stages more economically and can help developers study or carry out trials in complex conditions (Purnomo & Suparman, 2020; Rayanto & Sugianti, 2020). In this research, information was obtained that most PTIK students had the highest difficulty level in the development aspect. This development aspect includes the media development stage to realize the previous design stages, which consists of creating projects and scenes in development tools, uploading assets in the software, preparing scripts, compiling media into an Android application, and adjusting the final appearance.

In the results of the analysis of the development aspect, it can be seen that there are students who experience difficulties in creating projects and scenes in student development software with a high level of difficulty, where this difficulty takes the form of creating a new work area in the development software and adjusting the display size of the media layout to the size of the smartphone. Then, in the final appearance adjustment indicator, there are 10% of students with a high level of difficulty with a medium level of difficulty and 30% with low difficulty in adjusting the final appearance on each page with the storyboard that has been previously designed. In the indicators for preparing scripts for students with a high level of difficulty, there are three students with high difficulty, 18 with medium difficulty, and 9 with low difficulty. Judging from the indicator statement, two students need help understanding the programming structure of the development software used. One of the difficulties for beginner programmers is understanding the concept and construction of the program. Then, two students had high difficulty in finding coding errors in the development software used, and there were two students with a high level of difficulty in finding reference source code for the development application used (Bagus & Khuzaini, 2019; Lahtinen et al., 2005). Students find it easier and faster to prepare scripts with the features in the development software used. The

complete features in the development tools make it easier for developers to integrate media with other multimedia (Hidayati, 2022; Prastyo et al., 2021).

Other indicators in the development aspect are uploading assets and compiling media into an Android application. In these two indicators, there are still difficulties in the high category. Judging from the asset upload indicator statement, there was one student with high difficulty, where the student found it difficult to overcome errors in uploading assets into the project due to a mismatch in the asset format with the development software used by the student. Then, 24 other students had medium difficulty, and five had low difficulty when resolving asset upload errors. There is one student with high difficulty making learning media into an Android application, eight with medium difficulty, and 11 with low difficulty. Judging from the indicator statements, students can easily compile learning media into an Android-based application.

The design aspect is in the form of determining learning methods and strategies that will be developed in the Android learning media system, where this design aspect consists of the design or design of the Android learning media. Students with a high level of difficulty in making flowcharts where students find it difficult to implement the design of sequential activities in the media in the form of a flowchart. Then, regarding interface or storyboard design indicators, most students have paid attention to multimedia principles (principles of coherence, redundancy, signaling, etc.) in making storyboards, as evidenced by the absence of students with high difficulty with this statement. In designing learning media, paying attention to multimedia principles can attract users' attention (Kus Eddy Sartono et al., 2022; Pradana et al., 2020; Vivin Nur Afidah, 2015). However, five students still needed help implementing the function of using buttons, audio, interactivity and visuals into the storyboard. Students need to get the right references to understand the media material that will be developed (Nasution & Nisa, 2018). In making the background and layout, most students paid attention to font type and size. They created navigation buttons as instructions for using learning media, as indicated by the analysis of the majority's difficulty level at a low level on these indicators. Asset preparation is one stage of program creation (Hakim, 2018; Widyaningsih et al., 2020). In terms of creating assets, students have created an asset list to avoid asset shortages. Also, most students use assets provided by the development software, making it easier for students to create media.

This aspect of analysis collects information related to system requirements through functional and non-functional analysis and competency analysis to determine development goals. Difficulty in indicators of functional requirements and non-functional requirements, seen from the indicator statements that there are students who have difficulty formulating what processes must be implemented in the learning media system, as well as there are students with hardware specifications that do not support the development process and difficulty determining the software that will be used in android media development (Nasution & Nisa, 2018). Meanwhile, in the competency analysis indicator, there are no students with a high level of difficulty where students can analyze the main tasks that users/students will carry out in learning media by the indicators of student competency achievement. The indicator aspect of black box testing is that students can easily identify errors found in Android learning media to ensure the quality of the system acceptance level. Students can test applications on various smartphone specifications easily. Black box testing functions to test the system analysis results with development results. If the test produces valid results for all functions, the system's functional requirements have been met by the previous needs analysis (Puspa et al., 2018).

The evaluation aspect relates to preparing system evaluation tools for Android learning media users. Most students can prepare learning media evaluation questionnaires as user responses to the effectiveness of Android learning media. From the discussion of each aspect, it was found that development difficulties lie in activities in development software, such as uploading assets, and then related to understanding the programming structure and the ability to provide development needs such as test equipment and suitability of device specifications. This finding is strengthened by previous research findings stating difficulties in developing learning tools but still need to be detailed regarding the types and difficulties (Hamonangan & Sudarma, 2017; Malawi et al., 2017). Analyzing existing difficulties can guide developers to develop better learning media (Nasution & Nisa, 2018). The difficulty in developing Android-based learning media in this research is still limited to the development stage. Further research can examine the learning media products produced using the Success Story model more deeply.

4. CONCLUSION

The research results show that development difficulties exist in activities in software development. Based on research findings, all samples used modeling in developing Android-based learning media. The difficulties were developing software, understanding programming structures, and providing development equipment needs.

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