Validation of Android-Based Mobile Learning Product Development as Inferential Statistics Learning Media

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Abstract. Student learning outcomes are influenced by a variety of elements, one of which is pertinent to learning media assistance, particularly in the area of inferential statistics, which calls for both theoretical knowledge and extensive practice. As a result, learning gadgets that assist student practice in mobile learning in addition to having contents are required. RPS, case studies, teaching resources, learning recommendation links for video tutorials, and final course project designs will all be included in the resulting mobile learning. The overall goal of this project is to assess the viability of mobile learning for inferential statistics. The 4-D paradigm (Define, Design, Develop, and Disseminate) is used in this study's research and development (R&D) process. In this instance, though, it is only offered up to stage 4, which is product validation. With a validator percentage level of 86.87 percent, the product feasibility test findings indicated that mobile learning for inferential statistics falls into the extremely viable category. This demonstrates that while the resulting mobile learning has been shown to be practical for use in education, a number of additional research phases still require completion.

Keywords: Mobile Learning, Inferential Statistics, Feasibility Test.

1 Introduction

There have been periods when scientific and technological advancements have advanced extremely quickly. In the field of education, it is necessary for educators to make efforts to revitalize the use of technology in instructional activities. The creation of educational media is one attempt to integrate technology into the educational process. To enhance the quality of instruction, it is strongly advised that learning media be used during the teaching process[1].

Since technology is no longer regarded as novel, using it into instruction is one way to accomplish learning goals. This knowledge comes from the fact that students are no longer unfamiliar with using mobile devices, such as cellphones, PDAs, or tablets. The majority of students, particularly those attending college, own smartphones with more modern capabilities. Android is now the most popular smartphone and is evolving at a very fast pace, thus the development of learning materials for Android is extremely promising[2]. Smartphones are incredibly convenient to use and can have a significant impact on people's lives. However,

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the majority of students who use smartphones do so primarily for social media purposes, with only a tiny percentage using them to support their studying activities[3].

According to Rusman in[4], in order to address and resolve these issues, efforts must be made to enhance the quality of education by creating a learning system that is already focused on the needs of students (student center), meeting their needs, making facilities and infrastructure difficult, encouraging student participation and creativity, making learning more efficient and pleasurable, and creating learning based on information and communication technology. One comes from educational media.

In order to boost user interest in consuming learning media, it is also necessary to consider user motivation[5]. To increase students' interest in studying, the learning materials must also be created as interactively as feasible while taking into account the elements of effective learning multimedia development. Several media elements, including sound or audio, animation or moving images, video or audio-visual, text, symbols, and other media components, must be used into interactive learning multimedia, according to Reddi and Misrha in[6]. These components come together to form a cohesive whole that works in concert and becomes symbolic in order to help its users learn the information contained in the relevant media.

The evolution of multimedia learning in the face of technology's swift assault is undoubtedly an intriguing development in the field of education. In an attempt to meet the demands of students, learning materials that foster traits that are nearly inseparable from gadget reliance are being offered. This is also being attempted in the Inferential Statistics course.

The sad fact is that the low interest in reading among students is increasing. This phenomenon is easily observed on campuses. Many students are reluctant to buy books, even though they have been encouraged. Of course, many factors influence it. The low interest in reading books among students is because more people like to watch than read. There are even those who like to read but prefer to read from e-books rather than from books. This is because e-books are considered more practical, more mobile, and easy to carry anywhere[7]. Interesting media is readily available anywhere, at any time, and for good reason. Therefore, innovative learning materials that cater to the demands and characteristics of students who are practical and mobile are required to boost interest in reading[8].

Technology-based learning materials, such as mobile learning, which is readily available on Android smartphones, are one type of innovative learning that is pertinent to the needs of these kids. Students' academic performance could be enhanced by using Android-based learning resources, both in terms of learning motivation and cognitive domain learning results. Additionally, educational materials that incorporate the idea of mobile learning can help each student become more independent in their learning[9]. This is consistent with[10], which says that one of the purposes of learning media is an individualistic one, i.e., that it may meet the needs of each person based on their unique learning preferences and styles.

Based on this background, it is imperative to innovate learning media from traditional to digital (mobile) learning media in the era of the Industrial Revolution, which is characterized by human demands and reliance on the Internet of things. However, it is necessary to test the feasibility and effectiveness first before being used in learning. In addition to enhancing students' cognitive abilities, it is anticipated that this mobile learning multimedia will boost their motivation and independence in learning.

2 Research Methods

This research is development research, often known as research and development (R&D), with the goal of creating a specific product. There are various models used in the research and development process. The construction of the 4-D model (Four D) is the model utilized in this investigation. One concept for developing learning devices is the 4-D model. Thiagarajan, Dorothy, and Melvyn (1974)[11] created this model. The four primary phases of the 4-D development methodology are Define, Design, Develop, and Disseminate.

Third-semester students enrolled in the Economic Statistics course at the Economic Education study program, Faculty of Economics, State University of Medan during the academic year 2024/2025 served as the study's subjects. Three types of data analysis are used in this study: practicality testing, expert feasibility testing using the Likert scale approach, and instructional module effectiveness testing. In particular, this essay just looks at whether mobile learning is feasible.

In the context of the feasibility test, the validator's assessment data is examined both qualitatively and descriptively, and it serves as a guide for product revisions that produce a workable final product. The validator uses a validation sheet to evaluate the produced product design. A Likert scale is used to measure the assessment outcomes for every component. Finding a person's place on a continuum of attitudes regarding attitude objects, from extremely negative to highly positive, is the primary goal of the Likert scale[12].

The responses to the instrument items in this study are divided into five categories. A score on a scale of 1 to 5 is assigned to each measured indicator, specifically:

Table 1. Feasibility Scale Indicator.

Scale	Information
5	Very good/very appropriate/ very proper/ very clear
4	Good/ appropriate/ proper/ clear
3	Not good enough/ not appropriate enough/ not proper enough/ not clear enough
2	Bad/ inappropriate/no proper/unclear
1	Very bad/ very inappropriate/ very not proper/ very unclear

The next stage is to determine whether implementing a teaching medium for mobile learning in inferential statistics is feasible. Following data collection, the average score is determined using formula[13] to determine the weight of each validator's response:

$$\text{Average total score} = \frac{\textit{Total Score}}{\textit{Number of Assessors}}$$

The following formula can then be used to determine the percentage result formula.

$$\textbf{Result} = \frac{\textit{Averange of Total Score}}{\textit{Maximum Score}} \times 100\%$$

The following standards serve as the foundation for feasibility categories:

Table 2. R&D Product Feasibility Criteria

No	Score in %	Feasibility Category

1	<21%	Totally Not Feasible
2	21-40	Not Feasible
3	41-60%	Quite Feasible
4	61-80%	Feasible
5	81-100%	Very Feasible

3 Result

The construction of the 4-D model (Four D) is the model utilized in this investigation. Define, Design, Develop, and Disseminate are the four primary phases of 4-D development, which include the following steps:

A. Define Stage

Establishing and defining the prerequisites for instruction is the aim of this stage. Analysis can be used to identify the goals and constraints of instructional materials. This phase is broken down into multiple steps, specifically:

a) Front-End Analysis. The goal of the front-end study is to pinpoint the fundamental issues with learning inferential statistics. At this stage, there needs to be a real picture of the existing problems and there needs to be alternative solutions to the problems. Some of the initial analyses in compiling inferential statistics on mobile learning are as follows:

1) Students' complaints stated that the course tends to be difficult and complicated and requires supporting learning facilities such as laptops, but not all students have them. So this course is very relevant to be taught in a computer laboratory that has the SPSS application available.

2) Statistics books tend to be expensive and not enough 1 books to support the course. If students are forced to have books, this becomes an obstacle in itself, and finally, students do not have books or buy books in groups. Presenting comprehensive mobile learning that offers students instructional resources and supplementary learning videos is essential to solving this issue.

3) Inferential statistics is a course that combines theory and practice that is arranged systematically and structured. Therefore, it is essential to create statistical teaching resources that outline the methods involved in conducting hypothesis testing, both manually and with SPSS.

4) The increasing challenges of data analysis techniques in education student theses such as the use of variance analysis (one-way ANOVA and two-way ANOVA) and path analysis (intervening and moderating), but in fact the material for these analysis techniques was not in the RPS for the previous course. Although ideally there needs to be an addition of advanced inferential statistics courses, but because the change of replacing/deleting courses with new courses requires a long administrative process, all of this is condensed in this course only.

b. Learner Analysis. Learner analysis examines learner characteristics relevant to the design and development of identified learning media.

The high level of student needs with regard to using devices (smartphones) and LMS SIPDA to support learning is one of the student analyses in the preparation of inferential statistics mobile learning. As a result, it is necessary to develop pertinent learning materials that are easy to use, convenient to access anywhere at any time, and in line with the characteristics of the students. Depending on the needs and learning preferences of the students, this Android-based mobile learning app for inferential statistics may be a suitable alternative.

c. Task Analysis. The goal of task analysis is to pinpoint and define the primary activities that students need to complete. Basic competencies (KD) and core competencies (KI) pertaining to the content that will be developed through learning media are included in task analysis.

Some task analysis in the preparation of inferential statistics mobile learning refers to Routine chores, small-scale research, idea engineering, projects, journal reviews, and CBR comprise the six KKNI tasks. In addition, there is a demand to design cases in the application of the course.

d. Concept Analysis. Concept analysis aims to identify and determine the main concepts to be taught, systematically organize, and detail the relevant concepts.

Some conceptual analysis in the preparation of inferential statistics mobile learning is presenting students' learning needs consisting of teaching materials, links to recommended relevant learning videos according to the material for each meeting, a column of individual routine assignment materials for each meeting, and a group assignment design for creating mini-research reports in the form of journals.

e. Learning Objectives Analysis (Specifying Instructional Objectives). Learning objectives analysis is conducted to determine learning objectives from the results of task analysis and concept analysis.

Some of the analysis of learning objectives in the preparation of inferential statistics mobile learning are students' ability to understand research theory and students' skills in processing data with various data analysis techniques. As well as students' ability to compile research reports in the form of published mini research articles/journals.

In designing the learning objectives for each meeting, they have been adjusted to the learning material:

Meeting 1	Study Contract
Meeting 2	Introduction to Inferential Statistics
Meeting 3	Data Typology and Ordinal to Interval Data Transformation with MSI
Meeting 4	Hypothesis Testing
Meeting 5	Analysis Prerequisite Test (Normality, Linearity, Homogeneity)
Meeting 6	Two Parameter Difference Test of Mean (Independent and Paired)
Meeting 7	Simple Correlation Test (Manual Calculation and SPSS)
Meeting 8	Multiple Correlation Test (Manual Calculation and SPSS)
Meeting 9	UTS (Mid Semester Exam)

Meeting 10 Simple Regression Test (Manual Calculation and SPSS)

Meeting 11 Multiple Regression Test (Manual Calculation and SPSS)

Meeting 12 Analysis of Variance - One Way ANOVA (Manual Calculation and SPSS)

Meeting 13 Analysis of Variance - Two-Way ANOVA (Manual Calculation and SPSS)

Meeting 14 Intervening Path Analysis (SPSS)

Meeting 15 Finalization of Course Output Draft

Meeting 16 UAS (Final Semester Exam)

The design in the inferential statistics mobile learning designed in this development research is equipped with teaching materials, recommendations for relevant YouTube video links and routine assignments for each meeting to explore students' learning understanding.

B. Design Stage

Before developing a learning media product for Android-based inferential statistics mobile learning, researchers designed it with the intention of making sure the content matched the demands of the topic. The data design, navigation design, and user interface design used in this study provide a general overview of how learning media have evolved.

The results of the inferential statistics mobile learning design in the development of this research are as follows:

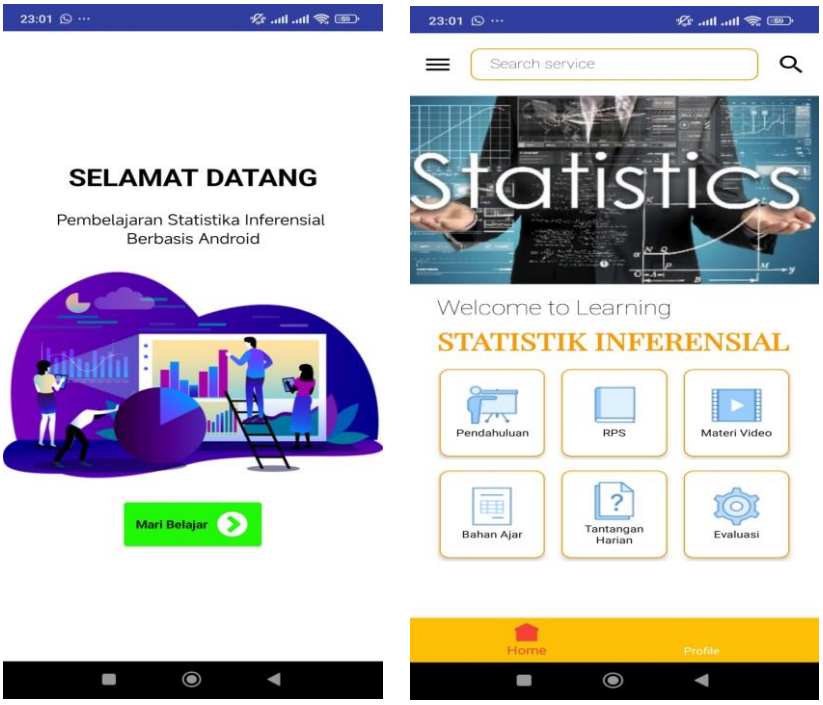

Fig. 1. Android-Based Inferential Statistics Mobile Learning Display

C. Development Stage

This stage aims to produce mobile learning multimedia according to expert input and development trials.

a. Expert Appraisal

Expert validation serves to validate the media and content of inferential statistical material in android-based learning media developed by researchers. Android-based learning media that has been created by researchers will be assessed by media experts and material experts. Through validation by experts, namely media experts and material experts, it can be known whether the multimedia created is feasible to implement or not. The results of the validation are used to improve the multimedia developed by researchers. If draft 1 has been validated and revised, draft 2 will be produced. Draft 2 will later be tested on students in the field on a limited basis.

The first step is the expert validity evaluation validation test for inferential statistical mobile learning. Two steps make up the validation process: 1) confirming the validity of the validation sheet questionnaire that the expert team will use to evaluate mobile learning, and 2) verifying mobile learning using a questionnaire that is distributed to the expert team. Two validators with backgrounds in statistics conducted the questionnaire validation.

Some experts who provide considerations regarding the validity of the content of teaching materials are (1) Dr. Zulkifli Matondang, M.Pd. (Lecturer in the Department of Building Engineering Education, Research and Evaluation Expertise Field); (2) Prof. Dr. Saidun Hutasuhut, M.Si. (Lecturer in the Department of Economics, Economic Education Expertise Field). The following are the results of the questionnaire validation by 2 validators as follows:

Table 3. Enter Mobile Learning Revisions from Validator

No	Name	Revision
1	Dr. Zulkifli Matondang, M.Pd.	• The homogeneity prerequisite test material is equipped with combined homogeneity. • The base project team design produces a draft of a mini-research article by the target journal template.
2	Prof. Dr. Saidun Hutasuhut, M.Si.	• In the intervening path analysis material, it is necessary to supplement it with Sobel test information that is available online. • For further research, relevant video tutorials can be independently developed that are by the material for each meeting.

Table 4 displays a number of the learning application's observed features. The following is an overall evaluation based on the findings of the two experts' considerations of the 16 aspects observed:

Table 4. Validity Aspects of Inferential Statistics Mobile Learning Content

No.	Aspects observed	Validators	
		1	2
1	Mobile learning according to curriculum / RPS	4	5
2	Mobile learning materials are by the expected basic competencies	4	3
3	The material in mobile learning is relevant to the material that students must learn.	5	4

No.	Aspects observed	Validators	
		1	2
4	The content of mobile learning material has correct and appropriate concepts	5	3
5	Mobile learning materials help explain concepts	4	5
6	*Mobile learning* loading case study	5	5
7	*Mobile learning*Loading KKNI assignment questions	5	5
8	Suitability of case studies and practice questions with the abilities to be improved	4	4
9	Suitability of the project to the material studied	5	4
10	The existing practice questions are by the learning objectives	5	4
11	The language used is good and correct	5	4
12	The language used is easy to understand and comprehend	5	5
13	The appearance and layout of mobile learning is attractive	4	5
14	The arrangement of images and other information in mobile learning is interesting	3	4
15	The font size used is clear	4	4
16	Students can easily access mobile learning independently	4	4
	Total Score of Validator	71	68

The next stage is to use the average total score analysis to examine the value data from the validator, specifically:

$$\text{Average of total score} = \frac{139}{2} = 69,5$$

The following formula can then be used to determine the percentage result formula.

$$\text{Result} = \frac{69,5}{80} \times 100\% = 86.87\%$$

The percentage result of the validator's value is 86.87%, which means that if we refer to Table 2 of the learning media feasibility criteria, Because it is between 81 and 100 percent, the feasibility category of the three validators' assessment results belongs to the extremely feasible group.

4 Discussion

The feasibility level for inferential statistics mobile learning has been reached, indicating that the prepared learning materials are appropriate for use in inferential statistics courses. Previous researchers have developed this statistical mobile learning approach[15,16,& 17]. The study's findings showed that the created mobile learning was successful in raising student learning outcomes and satisfied the requirements for use in instruction. Furthermore, it has been demonstrated that mobile learning can boost students' learning freedom and motivation since it offers the best possible learning support. It is also believed that this mobile learning will be able to enhance students' cognitive abilities in data analysis, both theoretically and with the use of data analysis programs like SPSS and so on.

5 Conclusion

Inferential statistics compilation Research and development techniques are used in mobile learning. A 4-D (Four D) model development design is used for the development research's goal. Following a number of research and development activities, the Define and Design phases were finished, and mobile learning products were deemed highly appropriate for educational purposes. However, the Develop and Disseminate series still needs to be finished before the entire mobile learning compilation is finished.

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