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Interactive Multimedia Based on Android: A Learning Management System in Elementary School

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ABSTRACT

This study aims to improve student learning outcomes through the development of an interactive multimedia application based on Android as an online learning management system for elementary school students that is valid, practical, and effective. The application development uses the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The subjects of the study consisted of expert validators, teachers, and fourth-grade students of the elementary school Laboratory University of Nusantara PGRI Kediri. The research instruments included a media and language expert validation questionnaire, teacher and student response questionnaires, and student learning outcome tests. The results showed that the developed multimedia application met the valid criteria with an average score of 85.57%. The practicality of the application is classified as very practical based on the positive responses of teachers of 85% and students of 82%. The application effectiveness test showed a significant increase in student learning outcomes with an N-gain score of 66%, included in the fairly effective category. Thus, this application is feasible and recommended as an alternative online learning medium at the elementary school level. Further research is recommended to expand the scope and variety of application content.

Introduction

The essence of effective learning is a teaching and learning that is not only focused on the results achieved by students, but how an effective learning process can provide a good understanding, intelligence, perseverance, opportunity, quality, and can provide changes in behavior, and apply it in the lives of students [1]-[3]. Various problems during the teaching and learning process in the school are at the time of learning, the teacher only uses image media, the attention of students in following the learning process is very minimal, where this is marked by the number of students who are not pay attention and playing with their seatmates, The same problem was also found in other studies [4], [5]. However, in contrast to learning that uses audio-visual media, the response shown by students is very enthusiastic, where this is indicated by students willing to listen to orders from the teacher, and students are not play with friends next to, this was also found in other studies [6]-[8].

Based on data from the BPS-Statistics Indonesia, National Socioeconomic Survey, the number of cell phone users in Indonesia (urban and rural) currently reaches 90,54%, which is a very significant increase compared to 2018, which was 88.46% [9]. If viewed from the data, it can be said that the facilities for conducting online learning are already fulfilled. The solution that can be done to improve the quality of online-based learning is very simple that is, it takes a learning medium that can facilitate learning so that it runs practically, effectively, and can attract students' interest in learning. Media is a tool to convey all information or messages from one party to another or from one place to another [10], [11], while learning media is an integral component of the learning system. It can be interpreted that the learning process can not be separated from the learning media. Without learning media, the teaching and learning process becomes monotonous, and students are less motivated in learning activities [12].

Learning media that can facilitate learning in the digital era are media in the form of applications on mobile smartphones [13]-[15]. An application is a subclass of computer software that utilizes direct computer capabilities to perform a task that the user wants. Applications are software programs designed to run on a computer/tablet/mobile phone for a particular purpose [16]. Of these various applications, the most popular in Indonesian society is an application on the Android operating system (89,85%) [17]. There that the factors that cause the popularity of Android applications are as follows: speed factors, productivity aspects, design creativity, flexibility, and reliability.

One of the smartphone applications that can be used is the Android-based application. This application can be developed to support the online learning process that presents material in the form of text, images, audio, video, and multimedia. The Android application developed in this study has the following components:

1. contains access for grades one to six elementary school, and contains a theme section, each theme is assigned a sub-theme section, and each sub-theme is assigned a section for each lesson.
2. contains two different user interfaces, namely the user view as a teacher and the user view as a student.
3. The view as a teacher contains a menu of managing schedules, assignments, lessons, and student lists.
4. The view as a student contains a menu of the homepage, meetings, schedules, and profiles.
5. flexibility of application content that can be filled in as needed.
6. can be accessed openly, provided that the application has been installed on the smartphone and has been registered.
7. easy to use because it is specially designed for elementary school learning.

The Android application is an online mobile learning media platform, this application can be used as a learning medium in the classroom by teachers, this application can also be accessed anywhere and anytime, the display presented is managed concisely and flexibly, and contains various media such as video, audio, and so on that can be tailored to the needs of students. Based on the above, this study aims to develop a valid, practical, and effective multimedia application based on the Android application in elementary school. In contrast to previous applications, which prioritized certain content in partial learning. This application focuses on managing learning management in one full school year.

Literature Review

In ensuring the feasibility of this application, that to find out whether an application-based learning media is suitable for use by end-users, which can be reviewed through several aspects. Appropriateness, which is an aspect that states: the suitability of the material possessed by the media with the characteristics and curriculum of the local school or school. Accuracy and clarity are aspects that state the appropriateness of the media in terms of accuracy, timeliness, and clarity in explaining the material, so as not to cause bias. In addition, the media must be by the level of difficulty of the students. Screen presentation and design is an aspect that states the feasibility of the media in terms of the display (user interface), such as the combination of colors used, images and writing that are coherent and harmonious with one another, the text that is presented is clear and easy to read by students, the existence of narration and at the same time videos that can provide direct examples that can be applied in everyday life [18].

In addition, it is important to consider the principles of interactive multimedia. The principle of coherence emphasizes the use of only relevant words, images, sounds, and videos

that directly support the material being presented. The principle of segmenting involves breaking down complex and complicated content into simpler, more manageable parts to enhance student understanding. The multimedia principle suggests that learning materials are more effective when they include images, audio, video, or animation, rather than relying solely on text. Lastly, the principle of interactivity highlights that students learn more effectively when they can control and adjust the pace at which learning materials are presented [19]. In interactive learning multimedia programs, the role of the navigation buttons on each frame is very important, this is because students can adjust their learning speed, so students can learn more optimally. In addition, the application of interactive principles in multimedia learning, including quizzes, simulations, games, and others, is very much needed.

Materials and Methods

A. Research Design

Android app development procedure uses stages from the ADDIE model [20]. The ADDIE model was chosen because the steps of this model are structured, flexible, emphasize learners, are suitable for learning frameworks, are easy to implement, and use a centered evaluation phase that can more easily produce measurable and specific results. According to a survey it shows that the ADDIE model is the most widely used instructional design model (67.3%) [21]. Table 1 summarizes the stages and associated activities, tools, and requirements.

Table 1. The ADDIE Phases

Stages	Description and Activities	Tools / Technologies / Requirements
Analyze	Data collection on student characteristics, teacher and student technological readiness, school facilities, and multimedia needs.	-
Design	Creation of a draft or sketch of the media to be developed.	-
Development	Realization of the conceptual framework into a product after evaluating the design. Software and hardware tools are selected and utilized.	**Software Tools:**• macOS Catalina (OS)• Firebase (database)• Java (programming language)• Android Studio (mobile app editor)• Adobe XD (UI design)**Minimum Hardware:**• MacBook Air 13-inch (Mid 2013)• 1.3 GHz Dual-Core Intel Core i5• 4GB RAM• Intel HD Graphics 5000**Android Device Requirements:**• OS: Android v5.0 Lollipop (API Level 21)• RAM: 3GB• Storage: 32GB
Implementation	The Android app-based learning media is integrated into the school learning process.	Android mobile devices
Evaluation	Conducted throughout all development stages to validate the product. Involves data collection from validators and users (teachers and students).	Validation instruments; data collection from users and validators

B. Participants

Data was collected from May to August 2024. The subjects of this study were two expert validators, fourth-grade teachers, and 20 fourth-grade elementary students in the elementary school laboratory University of Nusantara PGRI Kediri. In this study, the data collection instruments used were questionnaires and tests. Questionnaires are used to determine the validity of the expert validator and the practicality of the developed media from the teacher and the student. The test is used to determine the level of effectiveness of the media to be developed.

C. Research Instrument

The questionnaires needed in this research are media construction validation questionnaires based on the theory above [18]-[22], linguist validation questionnaires, teacher response questionnaires, and student response questionnaires. Measurement validation questionnaire using a Likert scale with five levels (1-5) of agreement. Teacher and student response questionnaires use "yes" and "no" questions.

Table 2 outlines the types of validation questionnaires used to assess the quality of an interactive learning media product. It includes two main data types: media construction validation and linguist validation. Each type is evaluated across specific aspects such as coherence, segmentation, multimedia, and interactivity principles (for media construction), and language relevance (for linguistic validation). A total of 24 indicators are used to ensure that the media is visually appealing, functionally interactive, and linguistically appropriate for the target student audience.

Table 2. Instrument Grid of Validation

No	Data Type	Aspect	Indicators
1	Media Construction Validation Questionnaires	Coherence Principle	1. The choice of font style 2. Font size accuracy 3. Media attractiveness design
		Segmentation Principle	4. Neat presentation of learning 5. Learning menu management flow 6. Consistency in the distribution of learning 7. The effectiveness of the presentation of theme segmentation
		Multimedia Principle	8. There is a feature to upload images 9. There is a feature for uploading videos
		Interactivity Principle	10. Accurate use of navigation buttons 11. Navigation performance accuracy on each feature 12. Ease of using Android 13. Compatibility of feature functions 14. Flexibility (can be used independently and guided)
2	Linguist Validation Questionnaires	Language Relevance Aspect	15. Using good and correct language rules 16. Use common terms 17. The language used is straightforward, and at the level of students

No	Data Type	Aspect	Indicators
			18. Use communicative and informative language 19. The accuracy of the use of local terms or language in describing the contents 20. The sentences used can convey the content of the material or information properly 21. Sentences used are simple, according to the target 22. Spelling accuracy 23. Consistency in the use of terms 24. Accurate and consistent use of punctuation and symbols

Table 3 shows the structure of the response questionnaires used to evaluate the effectiveness of an Android-based learning application from two perspectives: teachers and students. The Teacher Response Questionnaire includes 10 items assessing the app's alignment with instructional needs, content organization, assessment facilitation, and usability in online teaching. The Student Response Questionnaire also includes 10 items focused on user motivation, readability, accessibility, engagement, and overall user satisfaction. These questionnaires are designed to gather feedback on the app's practical value in enhancing the teaching and learning experience.

Table 3. Instrument Grid of Teacher and Student Respons

No	Data Type	Questions
1	Teacher Response Questionnaire	1. The features provided by the Android App are by the needs of online learning 2. The material in the Android App is by learning outcomes 3. The material in the Android App is by the learning objectives 4. The Android App makes learning mapping easy 5. Learning materials on the Android App are neatly organized 6. Android App can motivate educators to develop learning materials 7. The Android App makes it easy for educators to provide an assessment of the results of student assignments 8. The Android App helps educators evaluate students' disciplinary attitudes 9. The menu presented on the Android App is easy to understand 10. Features in the Android App help educators carry out online learning
2	Student Response Questionnaire	1. The Android App increases my study motivation 2. The writing on the Android App can be read clearly 3. Illustrative images on the Android App can be seen clearly 4. The menu presented on the Android App is easy for me to understand 5. The Android App helps me collect assignments more easily 6. The Android App can motivate me to study hard 7. I can access the Android App anywhere and anytime 8. The Android App makes studying at home fun 9. Through the Android App, the learning material provided is no longer disturbed by inappropriate advertisements or news 10. I like using the Android App

The learning outcomes test instrument was used to measure the effectiveness of the product. This effectiveness test uses a one-way pre-test post-test design. There are two tests, namely the pre-test and the post-test. The purpose of the learning outcomes test in this study was to obtain data on the differences in student learning outcomes before and after using the mobile Android app as a learning medium. The material used for the test questions is thematic material about (1) ethnic and cultural diversity, (2) natural resources, and (3) interpreting poetry. The number of questions is 20.

D. Data Analysis

Data analysis in this study used quantitative analysis. This data is in the form of a validation score and a practicality score [23]. Validity and practicality using the formula from [23]. Equation 1 was used to calculate the validity and practicality. Table 4 is used to interpret the results.

$$\text{Validity and Practicality formula} = \frac{empiric\ score}{\max score} \text{ x } 100\% \quad (1)$$

Table 4. Interpretation of Validity and Practicality

No	Score Achievement Criteria	Practicality Level
1	81.00 % - 100.00 %	Very valid/ practical
2	61.00 % - 80.00 %	Quite valid/ practical
3	41.00 % - 60.00 %	Less valid/ practical
4	21.00 % - 40.00 %	Not valid/ practical
5	00.00 % - 20.00 %	Very valid/ impractical

Pretest and posttest results to test the effectiveness. Pre-test and post-test were conducted to determine the results of students' abilities in learning the learning material. The pre-test is used to determine students' prior knowledge before using the media platform Android app. The post-test is used to determine students' knowledge after using the media platform Android app. The results of the students' pre-test and post-test experiments were analyzed using the one-group pretest-posttest design. First, the prerequisite tests for normality (Kolmogorov-Smirnov) and homogeneity (Levene's Statistics) were carried out. After fulfilling the prerequisites, the tests were continued with the Paired T-test and Normalized Gain (N-gain) [24]. The difference between pre-test and post-test tested by the paired T-test, is very significant if sig. 2-tailed <0.005. The media is said to be effective in increasing from pre-test to post-test if the N-gain gets the "moderate" category, the interpretation of the N-gain (%) is "quite effective", and the classical posttest average is at least 75 points. N-gain uses the formula from [24]. Equation 2 was used to calculate the N-gain. Table 5 was used to categorize the results.

$$\text{N-gain} = \frac{post\ test\ score - pre\ test\ score}{ideal\ score - pre\ test\ score} \quad (2)$$

Table 5. Normalized Gain Category

Quality	N_{gain}	Category
Greatly increased	g ≥ 0.7	High
Increased	0.3 < g < 0.7	Medium
Quite increased	g ≤ 0.3	Low

The N-gain in percent was calculated using Equation 3. Table 6 was used to interpret the results.

$$\text{N-gain Score (\%)} = \frac{post\ test\ score - pre\ test\ score}{ideal\ score - pre\ test\ score} \text{ x } 100\% \quad (3)$$

Table 6. Interpretation of the N-gain Effectiveness

Percentage (%)	Interpretation
Less than 40.0	Ineffective
40.00-55.00	Less Effective
55.01-75.00	Quite Effective
More than 75.01	Effective

Results and Discussion

A. Analysis-Evaluation Stage

Based on the analysis stage, it is known that currently the use of Android smartphones has started to be widely used [17], but their utilization in education is still lacking. Even though specifically designed technology (in this case is smartphones) can make an effective contribution to learning and can help students reach their highest potential [25]. Technology has been playing an increasingly important role in teaching and learning due to its ability to boost students' motivation and provide them with opportunities to explore and acquire new knowledge and skills [26]. Mobile technology has emerged as a potential tool that supports the application of learning in the contemporary era [27], [28]. With mobile smartphone-based media, students did not have difficulty in using lecture notes, videos, and course materials related to online education [29].

Besides the rarity of education-based applications, teachers are also hesitant to use smartphones in class. The teacher thinks that if the smartphone is held by students, it is only about games that are not educational. 'Concern for students' was identified as a major barrier by non-users [30]. The rapid development of technology makes it impossible to prohibit students from carrying smartphones in class. Even though it was banned, students still violated it and continued to carry smartphones [31], [32]. Instead of prohibiting it, teachers should direct smartphones as educational tools while still providing rules so that smartphones do not become an interference [33]. Android application development on smartphones is still mostly found in partial development of one material at a time [34].

However, such concerns were not found in the elementary school Laboratory University of Nusantara PGRI Kediri. Based on school observations and teacher interviews, this school has shown readiness to integrate smartphone-based learning. This is supported by reliable technological infrastructure, including stable Wi-Fi access and institutional policies that allow the use of smartphones for educational purposes only. Most students come from middle to upper-class families, allowing them to access personal smartphones for learning. In addition, teachers, mostly from Generation Z, who have good technological literacy to utilize digital media in the classroom. The visual learning characteristics of students also support the selection of this class.

B. Design-Evaluation Stage

At this stage, a draft/sketch of the media to be developed is formed. Application Contents mapped becomes two parts, that is page for teachers and a page for students. As for designing an Android app, which will be developed using Adobe XD. The main purpose of this media is not only to deliver material and quizzes on one particular competency [35], [37], but can also be used for a full school year, so the interface of this media is more like a simple learning management system, where there are main features for teachers and students. In this design stage, the researcher pays attention to the concepts of media construction principle questionnaires (coherence, segmentation, multimedia, interactivity) [22] and Linguist Principle. Researchers also pay attention to the principles of visual media and aspects of suitability with the developmental stages of elementary school students, which are child-friendly and attractive to them.

C. Development-Evaluation Stage

1. Homepage

   On the main page (Fig. 1), there is a login system, which is useful to ensure that users have registered to access this media. If the user does not have access to log in to the application, then they can register by pressing the house icon in the upper right corner of the application, and then the school admin registers the school using the required school identity.

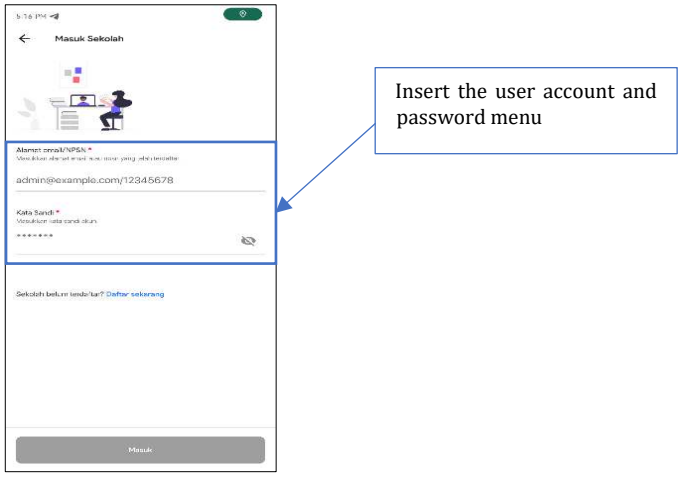

Fig. 2. Application Main Page

2. Pages for Teacher

On this page, several sub-menus can be accessed, including: (1) manage a schedule where teachers can fill in the schedule according to the learning schedule that has been made previously; (2) Theme management, in this section there are several sections, namely each theme contains a subtheme section, each subtheme consists of a learning section, in the learning section the teacher can fill in the learning materials to be achieved according to the indicators and learning objectives and the teacher can give assignments to students; (3) Manage assignments, in this section contains a collection of tasks that have been given by the teacher by the order of learning; (4) Manage students, in this sub menu the teacher can add and remove students.

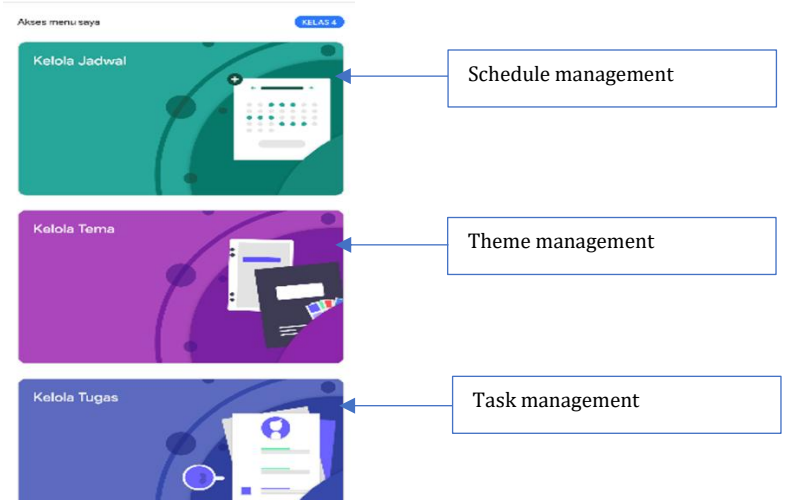

Fig. 3. Pages for Teachers

3. Pages for Students

This page has four main menus, namely the home menu, the theme menu, the schedule menu, and the profile menu. The page menu displays today's lesson schedule and nearby assignments to be completed by students. The theme menu contains a sub-theme section,

and each sub-theme contains a learning section. On this learning page, students can download materials and submit assignments. The schedule menu displays the overall schedule for the week and today's schedule. The profile menu contains the student's identity and a button to exit the Android account. Here's the design on the student page.

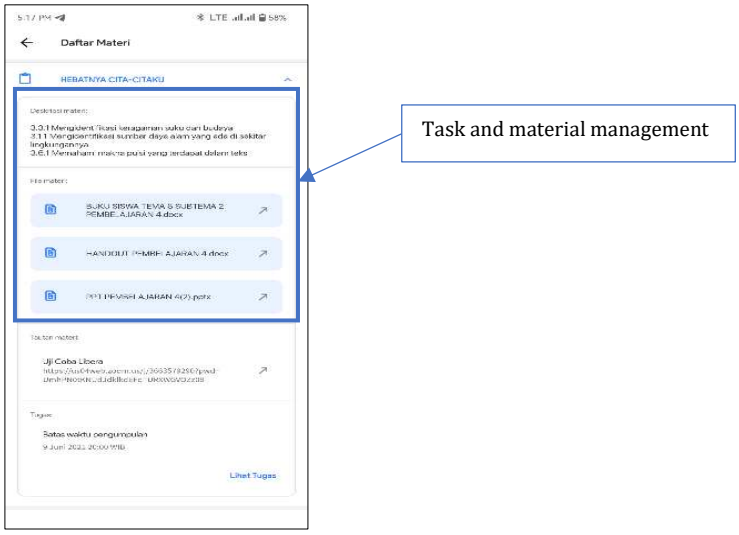

Fig. 4. Pages for Students

D. Validity Results

After the development stages above have been completed, validation is carried out by experts. The validity of the media can be determined by finding the average of the two values of the results from the validator. Fig. 5 shows the results of the average calculation of the media validation results.

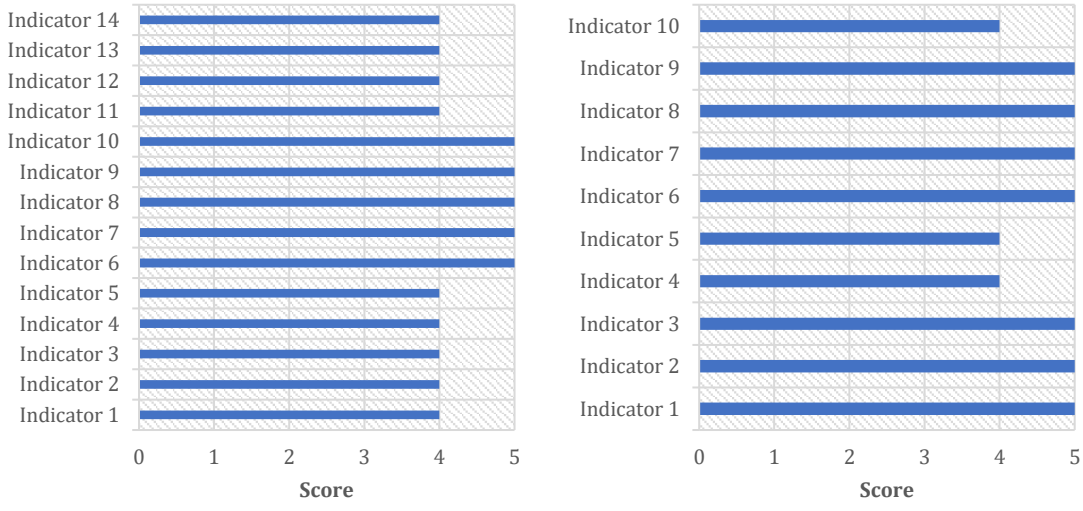

Fig. 5. The validity of Media and Language Aspects

Based on Table 7, the average value of media validity is 85.57%, so the Android media is included in the category of very valid. From media construction validation data with a score of

87.14%, the principle aspect of multimedia (indicator 6-10) gets a score of "5", compared to other aspects that still have a score of "4" (Fig. 5).

Table 7. Recapitulation of Media Validity Test Results

No.	Aspect of Validation	Score
1	Media Construct Validation	87.14%
2	Language Validation	84.00%
3	Total Value	171.14%
4	Average	85.57%

This is the strength of this media that this media has accommodated the concept of multi-media, meaning that the media contains elements of text, images, graphics, sound, animation, video interaction and others packaged into digital files, with these circumstances add strength to the delivery of material received by students (Edgar Dale's pyramid of learning). Even so, other aspects still get high scores.

The language aspect has a value of 84.00%. The aspect of language is something that needs to be considered in media development, because good and correct language will make it easier for users to understand the contents and instructions of the media. In addition to providing features for material for one academic year, this media also developed a thematic learning material with ethnic and cultural diversity, natural resources, and interpreting poetry. These three materials are only for testing validity, practicality, and effectiveness. Teachers can add material or assignments independently, thus making this media very comprehensive, stand-alone, and not too dependent on other media.

E. Implementation-Evaluation Stage

At the implementation stage, measurements are taken to assess the practicality of the media and the effectiveness of the media. The implementation was carried out at the fourth-grade elementary school. To support the system, an operational guidebook was developed. The operational guidebook was trained to the teachers who would implement the multimedia. Then the teacher trains the students in the steps of using multimedia along with the implementation of learning.

1. Media Practicality

   The practicality of the Android application can be determined by calculating the average response from teachers and students. Based on the trial results, it can be seen that the teacher gave a positive response to the Android application, as evidenced by the results of a percentage score of 85%, which is included in the very practical criteria and does not require revision. Then, for student responses, they gave a positive response, as evidenced by the score reaching 82%, which is included in the very practical criteria.

2. Effectiveness of Media

The process of testing the effectiveness of the media was carried out by analyzing the results of the students' pretest and posttest experiments with a one-group pretest-posttest design. Tables 8 through 12 present a comprehensive analysis of the effectiveness of the developed Android-based learning application through a series of descriptive and inferential statistical tests. These results are based on a pre-test and post-test design administered to measure improvements in students' learning outcomes after using the app.

Table 8 presents the descriptive statistics of both pre-test and post-test scores. The data indicate a substantial improvement in students' performance after the implementation of the learning media. The average pre-test score was 45.00 with a standard deviation of 14.43, while the post-test average rose significantly to 81.00 with a standard deviation of 12.15. Notably, the post-test mean exceeded the Minimum Completeness Criteria (MCC) of 75, demonstrating that the learning objectives were achieved by most students following the intervention.

Table 8. Descriptive Effectiveness Test Data

Type	Min	Max	Mean	Standard Deviation
Pre-test	25.00	70.00	45.00	14.43
Post-test	60.00	95.00	81.00 *	12.15

* above the minimum completeness criteria of 75

Table 9 shows the results of the normality test using the Kolmogorov–Smirnov method. The significance values for both pre-test and post-test scores were 0.200, which is greater than the threshold of 0.05. These results confirm that the data are normally distributed and suitable for parametric statistical analysis, such as the paired t-test.

Table 9. Prerequisite Test Results: Normality

Type	Sig. Kolmogorov-Smirnov[a]	Conclusion
Pre-test	0.200	Sig. 0.200 > 0.05, normal
Post-test	0.200	Sig. 0.200 > 0.05, normal

Table 10 displays the results of the homogeneity of variance test using Levene's statistic. The significance value (Sig. = 0.963) is also greater than 0.05, indicating that the variances between the pre-test and post-test scores are homogeneous. This further validates the use of parametric tests for analyzing the effectiveness of the application.

Table 10. Prerequisite Test Results: Homogeneity

Result	Levene Statistic	Sig.	Conclusion
Based on the Mean	0.002	0.963	Sig. 0.963 > 0.05, homogeneous

Table 11 reports the results of the paired sample t-test, comparing the means of pre-test and post-test scores to determine the statistical significance of the learning gains. The mean difference between the two tests is 36.43 with a standard deviation of 11.80. The two-tailed significance value (Sig. = 0.000) is less than 0.05, which confirms a statistically significant improvement in students' scores after using the learning application. This suggests that the app had a meaningful impact on student learning.

Table 11. Paired sample t-test

Mean	Std. Deviation	Sig. (2-tailed)	Conclusion
36.43	11.80	0.000	Sig. 0.000 < 0.05, there is a significant difference.

Table 12 provides the N-Gain analysis, which quantifies the effectiveness of the intervention. The N-Gain index score of 0.66 falls within the “medium increase” category, corresponding to a 66% gain in learning performance. According to standard interpretation guidelines, this score is classified as “Quite Effective,” indicating that the media significantly enhanced students’ understanding and learning achievement.

Table 12. N-Gain Index, Classification, N-Gain Percent, and Interpretation

N-Gain Index score	N-Gain Index Classification	N-Gain (%) score	N-Gain (%) Interpretation
0.66	Medium Increase	66%	Quite Effective

Overall, the statistical results summarized across these five tables demonstrate the effectiveness of the Android-based learning media. The application not only improved students' academic performance significantly but also met statistical criteria for normality, homogeneity, and meaningful learning gains. These findings validate the use of the developed digital media as an effective instructional tool in the learning process.

This finding is supported by previous research that demonstrates the positive impact of interactive multimedia on learning outcomes. As highlighted by Arum et.al, such media can significantly enhance student engagement and understanding [37]. Moreover, interactive multimedia integrated into Learning Management Systems (LMS) has been shown to yield good performance, proving its efficiency in various aspects, including system robustness, device compatibility, and scalability [38]. Additionally, the Cognitive Theory of Multimedia Learning (CTML) explains that combining visual and auditory elements in multimedia enhances comprehension and retention, further contributing to the effectiveness of this medium in improving learning outcomes [39].

This media contains multi-media elements, meaning that there are many channels to maximize the delivery of material, so that it has a fairly good impact on student post-tests, and concluded that the media can be used in further learning. Learning has a complex nature because it involves pedagogical, psychological, and didactic aspects simultaneously. Therefore, online learning is not just conveying material through internet media, nor just giving assignments and questions sent through social media applications. Online learning must be planned, implemented, and evaluated just like learning that occurs in the classroom [40]. If mobile learning is not managed well, it will cause excessive cognitive load on students and have negative effects [41]. Online learning with smartphones must be managed using a good system, and teachers must make clear rules, so that instead of smartphones aiming to help learning, they interfere with learning.

Conclusion

Based on the analysis of the research results and discussions that have been carried out, the Android-based interactive multimedia application developed is suitable for use as an alternative online learning medium at the elementary school level. This conclusion was obtained through three main aspects of the feasibility evaluation, namely validity, practicality, and effectiveness. In terms of validity, this application achieved a very valid category with an average validation score from construction media and language experts of 85.57%. The practicality aspect also showed very good results, with a positive response from teachers of 85% and students of 82%, indicating that the application is easy to use and meets the needs of the online learning process.

In terms of effectiveness, the implementation of the application has a significant impact on improving student learning outcomes, as evidenced by the results of the pretest and posttest tests, which showed an average student posttest score of 81.00, exceeding the minimum completeness criteria (75). Analysis of the increase in learning outcomes through the N-gain index of 66% indicates that the application has a level of effectiveness in the fairly effective category. Thus, this application not only facilitates the management of learning materials for a full school year flexibly, but is also proven to be able to increase student motivation and academic achievement.

Limitations and Suggestions

This research is limited by its narrow focus on the University of Nusantara PGRI Kediri. The sample size was relatively small, in elementary school, which may limit the generalizability of the findings to broader educational contexts. Despite these limitations, this research provides valuable insight into how learning using a learning management system can make learning more effective. Further research is recommended to test this application on a wider

scale with various educational backgrounds. In addition, it is also recommended to develop additional content and features to improve the functionality and effectiveness of the application in supporting various learning contexts.

Conflict of Interest

The authors declare that there is no conflict of interest.

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